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PEDRO ALEXANDRE SANTOS VELOSO

ESSAYS IN ECONOMICS OF EDUCATION: EVIDENCES FROM BRAZIL

FORTALEZA
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Tese apresentada ao Programa de Pós-Graduação em Economia do Faculdade de Economia, Administração, Atuária e Contabilidade da Universidade Federal do Ceará, como requisito parcial à obtenção do título de doutor em Economia. Área de Concentração: Economia.

Orientador: Prof. Dr. Guilherme Diniz Irffi.
Coorientador: Prof. Dr. Rafael Barros Barbosa.

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”Skills beget skills. Learning begets learning. And the earlier you start, the greater the effect.” (James Heckman, 2004)

ABSTRACT

In the first chapter, we aim to assess the impact of school management practices on educational outcomes in municipalities at Ceará's border. Using a Regression Discontinuity Design (RDD) and Spatial Regression Discontinuity Design (Spatial RDD), the methodology evaluates the educational reform in Ceará across schools from 2007 to 2017. The results reveal a positive effect of 0.012 SDs in management practices on schools that received educational reform in Ceará. This research provides evidence on how targeted interventions can strengthen administrative practices and support learning improvements. However, the findings are slightly smaller than other documented cases due to the broader, systemic nature of the policy. The second chapter analyzes the impact of school management quality and educational reforms on student proficiency, retention, and abandonment rates in Ceará, Brazil. Using a difference-in-differences-in-differences (DDD) approach, the paper evaluates the interplay between result-based financing (RBF), technical assistance (TA), and pre-existing management quality as measured by the School Management Quality Index (SMQI). The results show that schools with above-median management quality experienced significant improvements in student outcomes, particularly in 5th grade. By 2015, these schools outperformed their counterparts in border states by 0.1 SDs in mathematics and 0.09 SDs in language. For retention and abandonment, substantial reductions were observed in primary education, with significant decreases in retention starting in 2009 and abandonment from 2013 onward. These improvements translated into estimated municipal savings of $R\$25,992,769.28$ between 2011 and 2017. Additionally, financial incentives like the *Prêmio Escola Nota Dez* (PEN10) rewarded schools with good management practices, providing them with $R\$27,314,353$ more in bonuses compared to poorly managed schools over the same period. These economic savings and incentives underscore the dual benefits of improved management practices in reducing inefficiencies and enhancing student

outcomes. However, secondary education outcomes showed limited improvements, reflecting the systemic challenges associated with this educational stage, such as socioeconomic disparities and cumulative learning gaps. This study contributes to the literature by demonstrating how school management quality mediates the success of educational reforms. It bridges a critical gap by linking management practices to economic impacts, offering actionable insights for designing sustainable and equitable education policies. The findings emphasize the importance of integrating management reforms with targeted interventions to address disparities and achieve long-term improvements across all education levels. In the third chapter, we investigate the policy of redistributing state tax (ICMS) transfers based on the aggregate educational performance of the municipalities (*Quota-Parte* program). This chapter examines whether the ICMS Law, implemented in 2009, affected the composition of municipal spending, particularly if it increases the expenditure on education. The results show that receiving more resources from the ICMS Law did not produce a higher expenditure on education; however, municipalities increased the total non-educational expenditure. Specifically, for each real received by the municipalities due to the *Quota-Parte* program, R$ 0.45 was spent on education (R$ 0.23 in Elementary Education) and R$ 1.96 on total expenditure per capita. In the second part of the paper, we ask if the municipalities that benefited from this policy allocate their resources to higher-performing schools, consequently increasing the inequality among schools within municipalities. We find evidence of possible targeting in public spending on education for the best-performing schools. The results suggest that policymakers need to pay close attention to adopting this incentive scheme of redistribution based on educational performance because of the risk of an increase in inequality in the schools within the municipalities.

Keywords: School Management; RDD; Spatial RDD; Educational performance;

Retention; Abandonment; DDD ; Educational financing. Intergovernmental transfers.

JEL Classification: I25, H7, M5, I22, I28, H70

RESUMO

No primeiro capítulo, nosso objetivo é avaliar o impacto das práticas de gestão escolar nos resultados educacionais em municípios na fronteira do Ceará. Utilizando um Desenho de Descontinuidade de Regressão (RDD) e um Desenho de Descontinuidade de Regressão Espacial (RDD Espacial), a metodologia avalia a reforma educacional no Ceará em escolas de 2007 a 2017. Os resultados revelam um efeito positivo de 0,012 SDs nas práticas de gestão em escolas que receberam a reforma educacional no Ceará. Esta pesquisa fornece evidências de como intervenções direcionadas podem fortalecer práticas administrativas e apoiar melhorias no aprendizado. No entanto, os achados são ligeiramente menores do que outros casos documentados devido à natureza mais ampla e sistêmica da política. No segundo capítulo, analisamos o impacto da qualidade da gestão escolar e das reformas educacionais nos índices de proficiência, retenção e abandono dos alunos no Ceará, Brasil. Utilizando a abordagem de diferenças-em-diferenças-em-diferenças (DDD), o artigo avalia a interação entre o RBF, TA e a qualidade de gestão pré-existente, medida pelo SQMI. Os resultados mostram que escolas com qualidade de gestão acima da mediana apresentaram melhorias significativas nos resultados dos alunos, especialmente no 5º ano do ensino fundamental. Até 2015, essas escolas superaram seus pares nos estados fronteiriços em 0,1 SDs em matemática e 0,09 SDs em linguagem. Em relação à retenção e ao abandono, observou-se uma redução substancial no ensino fundamental, com quedas significativas na retenção a partir de 2009 e no abandono a partir de 2013. Essas melhorias resultaram em uma economia municipal estimada de $R\$25,992,769.28$ entre 2011 e 2017. Além disso, incentivos financeiros como o Prêmio Escola Nota Dez (PEN10) premiaram escolas com boas práticas de gestão, concedendo-lhes $R\$27,314,353$ a mais em bônus em comparação às escolas com gestão deficitária no mesmo período. Essas economias e incentivos econômicos destacam os benefícios duplos das práticas de gestão aprimoradas na redução de

ineficiências e na melhoria dos resultados dos alunos. No entanto, os resultados no ensino médio mostraram melhorias limitadas, refletindo os desafios sistêmicos associados a esse estágio educacional, como disparidades socioeconômicas e lacunas de aprendizagem cumulativas. Este estudo contribui para a literatura ao demonstrar como a qualidade da gestão escolar medeia o sucesso das reformas educacionais. Ele preenche uma lacuna crítica ao conectar práticas de gestão a impactos econômicos, oferecendo insights práticos para o desenho de políticas educacionais sustentáveis e equitativas. Os achados enfatizam a importância de integrar reformas de gestão com intervenções direcionadas para abordar disparidades e alcançar melhorias de longo prazo em todos os níveis de ensino. No terceiro capítulo, investigamos a política de redistribuição das transferências de ICMS com base no desempenho educacional agregado dos municípios (programa *Quota-Parte*). Este capítulo examina se a Lei do ICMS, implementada em 2009, afetou a composição dos gastos municipais, em particular se aumenta os gastos com educação. Os resultados mostram que receber mais recursos da Lei do ICMS não produziu um maior gasto com educação; entretanto, os municípios aumentaram o gasto total não-educacional. Especificamente, para cada real recebido pelos municípios devido ao programa *Quota-Parte*, R$ 0,45 foi gasto em educação (R$ 0,23 no Ensino Fundamental) e R$ 1,96 em gasto total per capita. Na segunda parte do artigo, perguntamos se os municípios que se beneficiaram dessa política alocam seus recursos para escolas com melhor desempenho, aumentando, assim, a desigualdade entre escolas dentro dos municípios. Encontramos evidências de possível direcionamento dos gastos públicos em educação para as escolas de melhor desempenho. Os resultados sugerem que os formuladores de políticas precisam prestar atenção à adoção desse esquema de incentivo de redistribuição baseado no desempenho educacional devido ao risco de aumento da desigualdade entre as escolas dentro dos municípios.

Palavras-chave: Gestão Escolar; RDD; RDD Espacial; Desempenho Educacional; Reprovação; Abandono; DDD; Financiamento Educacional; Transferências Intergovernamentais.

Classificação JEL: I25, H7, M5, I22, I28, H70

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1 INTRODUCTION

This thesis examines how school management quality and performance-based public policies affect educational outcomes, resource allocation efficiency, and equity in the education system, focusing on the case of the state of Ceará, Brazil. The central hypothesis is that higher-quality school management practices enhance the effects of educational reforms and performance-based financing mechanisms, generating improvements in learning and efficiency. However, such impacts may be heterogeneous and, in specific contexts, may produce unintended consequences, such as widening intra-municipal inequalities. The overall objective is to empirically analyze this relationship by combining different impact evaluation methodologies to understand both the direct effects on school performance and management, as well as the broader implications for resource distribution and educational equity.

The first chapter evaluates the effect of educational reforms implemented in Ceará on school management practices, with particular attention to schools located along the state's border. The hypothesis is that exposure to this set of reforms, combined with a supportive institutional environment and incentives, fosters measurable improvements in school management. To investigate this, a Regression Discontinuity Design (RDD) and a Spatial Regression Discontinuity Design (Spatial RDD) are employed, comparing schools in Ceará's border municipalities with schools in neighboring states between 2007 and 2017. The results indicate a positive effect of 0.012 standard deviations on management practices in treated schools, demonstrating the potential of the policy, although with a slightly smaller magnitude compared to other documented cases, possibly due to its broader and more systemic nature.

The second chapter deepens the analysis by investigating how pre-existing management quality interacts with results-based financing and technical

assistance policies to affect learning, retention, and dropout indicators. The hypothesis is that schools with better management can amplify the effects of such policies, achieving superior outcomes. The methodology applies a Differences-in-Differences-in-Differences (DDD) approach, combining data on results-based financing (RBF), technical assistance (TA), and the School Management Quality Index (SQMI). Findings reveal that schools with above-median management quality achieved significant gains, especially in 5th grade primary education, outperforming schools in neighboring states by 0.1 standard deviations in Mathematics and 0.09 in Language by 2015. There were also substantial reductions in retention (from 2009) and dropout rates (from 2013), leading to an estimated municipal savings of R$25.99 million between 2011 and 2017. Incentives such as the Prêmio Escola Nota Dez reinforced these results, awarding an additional R$27.31 million to well-managed schools. In contrast, effects at the secondary level were more limited, reflecting persistent structural challenges.

The third chapter investigates the redistribution policy of state VAT (ICMS) transfers based on municipalities' aggregate educational performance, established by the 2009 ICMS Law and operationalized through the Quota-Parte program. The objective is to determine whether this policy altered the composition of municipal public spending and whether it led to a preferential allocation of resources to higher-performing schools. The hypothesis is that increased municipal revenues tied to performance criteria could direct investments toward already advantaged schools, thereby risking increased inequality. The analysis shows that, for every additional real received via the Quota-Parte, R$0.45 was spent on education (R$0.23 specifically in primary education) and R$1.96 on total per capita expenditure, without a proportional increase in educational investment. Moreover, there is evidence of resource targeting toward higher-performing schools, suggesting a potential unintended consequence of exacerbating intra-municipal inequalities.

Taken together, the three chapters provide robust evidence that school management quality is a critical factor for the success of educational reforms and performance-based incentive policies. At the same time, they highlight the need to pay close attention to the distributive effects of such policies to ensure that gains in efficiency and learning are accompanied by greater equity in the education system.

In light of these findings, the dissertation is structured to guide the reader from the broader theoretical and empirical foundations to the specific policy analyses. Chapter 1 introduces the first empirical test of the central hypothesis, focusing on the direct effects of reforms on management practices. Chapter 2 extends the discussion to the interaction between management quality and complementary policies, assessing their combined impact on educational outcomes. Finally, Chapter 3 shifts the focus to fiscal incentives and resource allocation, exploring both their intended effects and possible equity trade-offs. This sequential approach allows for a comprehensive understanding of the mechanisms through which management quality and policy design shape educational performance and fairness.

2 EDUCATIONAL REFORM AND SCHOOL MANAGEMENT

2.1 Introduction

Over the past decades, Brazil has allocated approximately 5% of its GDP to education, placing it among the Latin American countries with the highest educational expenditure. However, this percentage falls significantly short of the 10% target set by the National Education Plan. Additionally, Brazil's nominal expenditure on education remains relatively low compared to other countries, largely due to its lower GDP per capita (Tesouro Nacional, 2023; OCDE, 2024).

Despite this commitment, most of the funding is directed towards primary education, and progress in student learning outcomes remains limited. International assessments indicate that Brazil still struggles to convert these investments into substantial improvements in academic performance. Additionally, regional differences in per-student spending alone cannot account for the significant disparities in learning outcomes observed across the country (World Bank, 2017; BARROS *et al.*, 2018).

Research suggests that governance inefficiencies and ineffective school management are critical factors contributing to persistently low student performance in developing countries (GLEWWE; MURALIDHARAN, 2016; MURALIDHARAN; SINGH, 2020). In the literature, "management practices" refer to a set of measurable and practical aspects that vary across institutional contexts. This study adopts the measurement framework developed by (LEAVER *et al.*, 2019; LEAVER *et al.*, 2022), which constructs a School Management Quality Index (SMQI) based on the Brazilian Basic Education Assessment System (SAEB) questionnaire.

Another essential element of school effectiveness is the role of principals as educational leaders. However, in recent years, educational policies have often overlooked the significance of school leadership, diverting attention from this crucial

aspect of school improvement (REBACK, 2008; FERNANDES; FERRAZ, 2014; MBITI *et al.*, 2019a; GRISSOM *et al.*, 2021). Jr (2014), Fryer *et al.* (2017), Bruns *et al.* (2018) show that management training for public school principals can yield significant gains in student performance, particularly in subjects like mathematics and language, while also fostering changes in teachers' classroom practices.

Although a strong correlation exists between effective management practices and student achievement, questions remain about which specific practices are most impactful and in what contexts. In Brazil, particularly in the state of Ceará, educational policies implemented since 2007 — such as results-based financing (RBF) and technical assistance (TA) —have demonstrated a positive impact on student learning outcomes (SHIRASU *et al.*, 2013a; PETTERINI; IRFFI, 2013; BRANDÃO, 2014a; CARNEIRO; IRFFI, 2018; SILVA, 2021; IRFFI *et al.*, 2021; CARNEIRO *et al.*, 2022). These policies incentivize improvements in school management, offering the potential to transform the quality of public education, especially in regions with historically low academic performance.

Measuring management practices also presents challenges. The literature does provide established instruments (BLOOM *et al.*, 2015; LEAVER *et al.*, 2019; HOOGERBRUGGE, 2019; LEAVER *et al.*, 2022), yet the range of possible actions for school managers varies significantly based on the institutional environment (BLOOM *et al.*, 2015; CRAWFURD, 2017; TAVARES, 2015; HWA; LEAVER, 2021; BORGES *et al.*, 2024).

Research consistently finds that improvements in school management can positively impact students (BRUNS *et al.*, 2018; HOYOS *et al.*, 2017; FRYER *et al.*, 2017; ROMERO *et al.*, 2020). A recent meta-analysis of school management programs in low- and middle-income countries reported an average learning gain of 0.033 standard deviations (ANAND *et al.*, 2023). In Brazil—the focal point of this study, similar effects have been observed (LEAVER *et al.*, 2019; LEAVER *et*

al., 2022; BRUNS *et al.*, 2018; HOOGERBRUGGE, 2019; BORGES *et al.*, 2024; BARBOSA, 2023), documenting effect sizes in low-stakes tests ranging from 0.02 to 0.07 SDs through various empirical approaches.

A comparison between developed and developing countries reveals a significant gap in school management quality, Bloom *et al.* (2015), Leaver *et al.* (2019), highlighting an opportunity for policy improvements in developing regions. In Latin America, school management quality and student learning outcomes continue to lag (BLOOM *et al.*, 2015; LEAVER *et al.*, 2019; AZEVEDO *et al.*, 2022; BARBOSA, 2023; BORGES *et al.*, 2024). Enhancing the productivity of essential figures within school systems, especially school leaders, is a promising direction for boosting student learning outcomes. Consequently, policymakers are increasingly interested in interventions prioritizing school leadership and effective management practices.

This chapter investigates whether the educational policies implemented in Ceará, including RBF and TA, have effectively transformed management practices in public schools. The central research question is: do these policies contribute to improvements in school management indicators? To answer this question, we employ the School Management Quality Index developed by Leaver *et al.* (2019), Leaver *et al.* (2022).

Our empirical strategy combines two Regression Discontinuity Design (RDD) approaches: a traditional RDD, which observes variations in management practices based on Ceará's border to other states distance, similar to Calonico *et al.* (2014), Dell (2010), Keele e Titiunik (2015), and a spatiall RDD, similar to Imbens e Zajonc (2011), Zajonc (2012), Keele e Titiunik (2015), Lehner (2023), which explores differences in policy implementation in different points of Ceara's border. This combination of methods enables us to capture the effects of policies in the school context with the heterogeneity of different points of the State of

Ceará. We also use covariates to control our results and get more accuracy into the results and use entropy balance by Hainmueller (2012) to control our covariates in 2007, before treatment. In observational studies, entropy balancing ensures precise covariate balance by reweighting data to match treatment and control groups on key covariate moments. This balance reduces model dependence, eliminates the need for repeated balance checks, and provides a more consistent basis for estimating treatment effects.

Our study seeks to fill a gap in the literature by providing insights into the educational outcomes of Ceará from a school management perspective; it also uses the Keele e Titiunik (2015), Lehner (2024b) approach to observe the heterogeneity across the border state. We explore the results at the school level; the key findings of our research indicate that schools in Ceará increased 0.012 SDs of school management compared to other border states between 2011 and 2017, and we also find some heterogeneity across the border.

These findings, analyzed in aggregate, suggest that the educational policies implemented, including managerial and technical support for schools, had a consistent and signficant impact on improving management practices. Although the results are smaller than those documented in the literature, this study contributes to understanding how structured interventions can strengthen management capacity in municipal schools in Ceará, reflected in better administrative and pedagogical outcomes.

The chapter is organized as follows. After this introduction, Section 1.2 presents the context, focusing on Ceará's socioeconomic and educational landscape and an overview of the RBF reform and TA within Ceará's educational system. Section 1.3 describes the data sources and the empirical strategy, including the Spatial Regression Discontinuity Design approach. Section 1.4 outlines the main findings, robustness checks, and placebo tests. Section 1.5 explores possible mechanisms

driving the results. Finally, Section 1.6 concludes the chapter.

2.2 Context

The State of Ceará is in northeastern Brazil, one of the country's poorest regions. With a population of 8.7 million, it ranks Brazil's eighth most populous state, and about three-quarters of its residents live in urban areas. In 2019, Ceará's monthly per capita income stood at US$233.80, well below the national average of US$356.93, making it the state with the fourth-lowest GDP per capita in the country[1]. Despite these challenges, Ceará has seen notable advancements in education[2] [3]. The state implemented a significant educational reform that improved literacy outcomes for elementary school students, using RBF policies as part of a broader educational reform program (LOUREIRO *et al.*, 2020).

2.2.1 Result-Based Financing Reform in Ceará

Educational ICMS policy implemented by the state of Ceará is one of the most innovative and effective initiatives in using intergovernmental transfers to improve the quality of public education in Brazil. Instituted by Legislation 14,023, approved in December of 2007 and effectively operationalized in 2009, this policy stands out for linking the distribution of part of the *Imposto sobre Circulação de Mercadorias e Serviços* (henceforth, ICMS) resources to the educational performance of municipalities, representing a significant shift from traditional distribution criteria based on population or territorial area (SIMÕES; ARAÚJO,

[1] Data on Ceará's economic activity, demographics, and socioeconomic characteristics are from (Instituto Brasileiro de Geografia e Estatística, 2019; CAVALCANTE *et al.*, 2019)

[2] The Economist magazine highlighted Ceará's educational model and its potential lessons for others. The article is available at https://www.economist.com/the-americas/2021/12/18/what-a-brazilian-state-can-teach-the-world-about-education.

[3] BBC News, one of the most influential journals in the world, also published an article about Ceará's education. The article is available at https://www.bbc.com/portuguese/articles/cev9g2jrxp0o.

2019; CARNEIRO; IRFFI, 2018; CARNEIRO *et al.*, 2022). Ceará's RBF model encourages municipalities to enhance educational quality by rewarding those that show progress in educational indicators, such as approval rates and performance in external assessments. This policy has strongly impacted municipal school networks, fostering greater cooperation and healthy competition among municipalities (LAUTHARTE *et al.*, 2021; SILVA, 2021; VELOSO; BARBOSA, 2021)

Educational ICMS policy was created when Ceará faced low-quality primary education, with significant challenges related to universal access and improving student learning. Since 1996, legislation stipulated that the discretionary municipal share (25%) would be allocated based on the proportion of education spending relative to municipal revenue (12.5%), population size (5%), and an equal share among municipalities (7.5%) (CEARÁ, 1996; HOLANDA *et al.*, 2007). This system, aimed to increase the number of students enrolled in Ceará's public schools, helping to reduce the presence of children and adolescents out of school—one of the state's main challenges at the time (MARQUES *et al.*, 2009). Data compiled by Irffi e Carneiro (2018) show that, in the 1990s, the average student age in Ceará indicated a school delay of over two years. A decade later, this age-grade distortion was reduced to approximately one year on average. Although the 1996 legislation, together with other policies, contributed to expanding access to education, it was unable to improve educational outcomes, as measured by portuguese and mathematics scores in SAEB (IRFFI; CARNEIRO, 2018; CARNEIRO *et al.*, 2022).

What sets Ceará's ICMS policy apart from others is its discretionary nature. This unique feature allows the state to set performance criteria for resource transfers, unlike other states that primarily use fixed criteria such as population and area. Linking transfers to educational performance, Ceará provides a clear incentive for municipal managers to prioritize student learning, focusing on the concrete impact of their actions. This policy is aimed at the municipal management level,

placing the mayor and their team as those directly responsible for implementing improvements in the local education system. Rather than focusing solely on students or teachers, Ceará's model directly targets the public municipal manager, encouraging them to achieve results to maximize resources allocated to education.

Ceará has adopted various initiatives to reverse the lower educational results, with reformulating the ICMS distribution criteria being one of the most significant changes due to introducing a RBF model to redistribute performance. The new legislation determined that 18% of the 25% ICMS share allocated to municipalities would be distributed based on the Education Quality Index (IQE), which measures both the level and evolution of students' performance in standardized exams in Portuguese and mathematics, as well as literacy rates (SIMÕES; ARAÚJO, 2019; CARNEIRO *et al.*, 2022).

The structure of educational ICMS calculations in Ceará involves a complex formula that considers current performance and progress in various educational metrics, such as approval rates and standardized test results. Each year, 25% of the state ICMS revenue is allocated to municipalities, with 18% of this 25% being distributed based on educational performance, 5% on health indicators, and 2% on environmental indicators. The formula includes two main indices: the Education Quality Index (IQE) and the Literacy Quality Index (IQA), which respectively assess the performance of elementary students and the literacy rate up to the second year of schooling (HOLANDA *et al.*, 2008). The following equation can describe the RBF model:

$$Quota_{ICMS,c} = 0.18 \cdot Educ_c + 0.05 \cdot Health_c + 0.02 \cdot Environment_c \qquad (2.1)$$

Where $Quota_{ICMS,c}$ is the QuotaParte for municipality c; $Educ_c$ denotes the education quality index for municipality c; $Health_c$ represents the average levels and progress in reducing infant mortality rates for municipality c; and $Environment_c$

is a binary variable indicating whether municipality c has an operational solid waste management system[4]. Notably, $Educ_c$ carries the greatest weight in the $Quota_{ICMS,c}$ distribution formula, with 18% out of the 25% allocated to municipalities depending on educational performance. Additionally, $Quota_{ICMS,c}$ an independent research institute calculates, the *Instituto de Pesquisa e Estratégia Econômica do Ceará (IPECE)*, based on data collected by the state government. Municipalities do not directly compile or submit data for $Educ_c$, $Health_c$, or $Environment_c$.

The initial implementation of education redistribution in 2007 was primarily focused on the early years of elementary school, and the IQE considered both portuguese and mathematics performance for 5th-grade students and the approval rate from the 1st to the 5th grade (LAUTHARTE *et al.*, 2021). This initial structure aimed to improve literacy and the basic quality of elementary education, prioritizing ensuring that children reached minimum learning levels in the early school years. In this initial model, literacy performance is weighted twice as much as Learning performance to induce greater efforts toward improvements in basic literacy, as shown in the following $Educ_c$ equation:

$$Educ_c = \frac{2}{3} \cdot Literacy_c + \frac{1}{3} \cdot Learning_c \tag{2.2}$$

Where $Literacy_c$ averages the level and time variation of literacy rates per municipality c. For literacy level (L_c^w), the formula weights the average literacy rate (L_c) on SPAECE enrollment rates ($Enroll\%_{,c}$) times half the standard deviation of Portuguese scores: $L_c^w = L_c \times \frac{\text{Enroll\%}_{,c}}{0.5\sigma_c^L}$. Combining these two weights aims to reduce potential negative selection of students into SPAECE and penalize municipalities with highly unequal learning performance. Based on the weighted literacy rates (L_c^w), the final index for level is $I_{literacy,c} = \frac{L_c^w - L_{min}^w}{L_{max}^w - L_{min}^w}$, divided by the sum of $I_{literacy,c}$ for

[4] The methodology for calculating these indices was defined by the government (HOLANDA *et al.*, 2008; MARQUES *et al.*, 2009)

all municipalities, $\sum_c I_{literacy,c}$. For the time variation component, the RBF formula considers the time difference between $L^w_{c,t}$ and $L^w_{c,(t-1)}$ in the same equations.

The $Learning_c$ component of the RBF formula has the same structure as the $Literacy_c$ component. It also considers levels and time variation at the municipal level, but instead of L^w_c and $L^w_{c,t}$, the formula uses weighted test scores in the 5th grade, denoted as T^w_c and $T^w_{c,t}$. All underlying calculations to find $I_{Learning,c,t}$ follow the same procedures as for $I_{literacy,c,t}$. However, different from $Literacy_c$, this component includes pass rates ($Enroll\%_{,c}$). More explicitly, the final $Learning_c$ indicator is given by:

$$Learning_c = 0.2 \cdot \frac{Enroll\%_{,c}}{\sum_c Enroll\%_{,c}} + 0.8 \cdot \left(0.4 \cdot \frac{I_{learning,c}}{\sum_c I_{learning,c}} + 0.6 \cdot \frac{\Delta I_{learning,c,t}}{\sum_c \Delta I_{learning,c,t}} \right) \quad (2.3)$$

In summary, the original RBF model indicates that municipalities demonstrating more significant improvements in literacy rates, pass rates, and learning scores receive a larger share of the *Quota-Parte* compared to those with lower overall performance. However, suppose higher test scores are achieved by limiting student participation in SPAECE or increasing disparity between high and low achievers. In that case, these municipalities are penalized with a reduced Quota-Parte allocation. Overall, the RBF model aims to incentivize local authorities to expand the number of students participating in standardized exams while simultaneously working to decrease learning disparities (HOLANDA *et al.*, 2008; MARQUES *et al.*, 2009; LAUTHARTE *et al.*, 2021).

In 2011, the government introduced a significant change to transfers through legislation 30,796, modifying the formula to give greater weight to learning levels and reduce disparities by encouraging efforts focused on students with lower performance (CARNEIRO *et al.*, 2022). This adjustment sought to enhance the system's equity by penalizing municipalities that showed significant varia-

tions in performance among their schools. The decree implemented four specific reformulations:

(i) $Enroll\%_{,c}$ was removed from $Learning_c$ and added to the $Educ_c$ component (weighting 0.05);

(ii) $Literacy_c$ replaced the weight for levels by 0.75 and for time variation by 0.25, instead of 0.5 each;

(iii) $Learning_c$ averaged test scores in Mathematics and Portuguese.

These first three modifications focused on increasing the importance of learning levels in the RBF mechanism, promoting equity and preventing manipulation (IRFFI; CARNEIRO, 2018; LOUREIRO *et al.*, 2020).

The last modification (iv) replaces the standard deviation in literacy rates (L^w) and test scores (T^w) with the percentage of students below critical learning levels. Along with simplifying the RBF formula, this change reflects the limited sensitivity of σ_c to local policies compared to the percentage of students below performance thresholds. Specifically, Literacy_c replaces σ_c^L with $(1-L_{\text{critical},c})^3 \cdot (1-L_{\text{partial},c})^1 \cdot (1+L_{\text{satisf},c})^2$, where $L_{\text{critical},c}$ is the proportion of students classified as illiterate, $L_{\text{partial},c}$ is the proportion of students classified as partially literate, and $L_{\text{satisf},c}$ is the proportion classified as satisfactorily literate. For Learning_c, the weight is given by $(1-\text{Port}_{\text{low},c})^2 \cdot (1-\text{Port}_{\text{high},c})^2$ for Portuguese, and Mathematics follows the same structure.

The 2011 recalibration started in 2013 and focused on literacy indicators, establishing differentiated weights for critical learning levels so that municipalities with high rates of students below proficiency minimums would receive fewer resources. This model adjustment aimed to reduce inequality within municipal networks and ensure that resources were allocated to encourage more homogeneous improvements. This re-design aims to penalize municipalities with higher percentages of students below minimum mathematics and language performance

thresholds.

In 2017, a new recalibration was made, and a new change was introduced to include the final years of elementary school. This allowed incentives to cover not only early learning but also the academic progress of students up to the 9th grade. This adjustment allowed for a broader view of educational performance and encouraged municipalities to focus on the continuity of student learning throughout the entire compulsory schooling phase.

This approach, being discretionary and results-oriented, introduces a financing logic that encourages results-driven management. Mayors' autonomy and freedom in resource allocation enable each municipality to develop educational strategies tailored to their local needs without rigid impositions regarding fund use. However, the demand for results also implies an expanded responsibility for managers towards the local community, as citizens become direct observers of the policies' impacts and improvements in educational performance.

Thus, the educational ICMS policy is a notable example of how results-based financing can be a powerful tool for improving public education. The Ceará experience has demonstrated that educational quality can be significantly enhanced through well-designed financial incentives and that fiscal policies can promote social development in low-income contexts. The Ceará model has inspired other Brazilian states to consider similar approaches, notably with the Constitutional Amendment No. 108 of 2020, which made it mandatory to include educational performance criteria in ICMS distribution. This policy remains a reference for Brazil and other countries interested in implementing educational funding models that align incentives with effective results (CARNEIRO *et al.*, 2022; SIMÕES; ARAÚJO, 2019; LOUREIRO *et al.*, 2020).

2.2.2 Technical Assistance - (Pacto pela Alfabetização na Idade Certa, PAIC)

The government approved in December of 2007 legislation 14.026, which started a Literacy Program at the Right Age (*Pacto pela Alfabetização na Idade Certa, PAIC*), a non-mandatory TA package available to all municipalities. This package includes actions from continuous teacher training and support for school management to providing structured materials, pedagogical diagnostics, and actions to standardized tests (COSTA; CARNOY, 2015; SEGATTO; ABRUCIO, 2016; LAUTHARTE *et al.*, 2021)

The TA was implemented as a response by the Ceará government to address the challenge of reducing child illiteracy rates in the state, especially among children in the most vulnerable regions. Based on data showing critical literacy levels in the early years of primary education, the Ceará government took the initiative to implement a comprehensive literacy policy capable of transforming primary education and ensuring that all children would be literate by the age of seven. This initiative was founded on the idea that early literacy is essential for students' academic and social success, directly influencing the quality of education and promoting long-term socioeconomic development (COELHO, 2013; SEDUC, 2012)

The partnership with the United Nations Children's Fund (UNICEF) was essential from the start of TA. With its expertise in promoting children's rights and inclusive educational policies, UNICEF helped to define the program's guidelines and methodologies, ensuring that it adhered to principles of equity and prioritized services for children in the most vulnerable situations. UNICEF provided technical support, structuring TA's main focus areas and establishing goals and performance indicators to guide monitoring and evaluation. This collaboration enabled the program to be developed more robustly, having a more significant

impact on reducing educational inequalities (SEDUC, 2016b)

In addition to UNICEF, *PAIC* collaborated with various institutions, such as the Association of Municipalities of the State of Ceará (*Associação dos Municípios do Estado do Ceará, Aprece*) and the Union of Municipal Education Leaders of Ceará (*União dos Dirigentes Municipais de Educação do Ceará, Undime-CE*). These entities were crucial in facilitating the program's implementation throughout the state, primarily as TA operated through a cooperative model between the state and municipal governments. This cooperation model allowed the program to be adapted to the local realities of each municipality, ensuring more targeted and effective service. The State Department of Education (SEDUC) also played a central role, providing ongoing guidance and technical support to municipal managers and educators, which helped integrate TA practices into municipal school networks (SEDUC, 2016c).

Based on this collaborative framework, TA established itself as an innovative and effective public policy. The involvement of different institutions and the creation of a collaborative framework allowed Ceará to tackle child illiteracy in a structured and integrated manner. This approach broadened the program's reach and sustainability, creating a model that would later be recognized and replicated in other regions of Brazil (SUMIYA *et al.*, 2017).

The period from 2005 to 2006 was crucial for the design and development of the *PAIC*, as during this pilot phase, the program's foundations were tested and refined before its official implementation in 2007. During this experimental phase, the government of Ceará launched *PAIC* in 60 municipalities, with technical support from UNICEF and in collaboration with the Association of Municipalities of the State of Ceará (Aprece - Associação dos Municípios do Estado do Ceará) and the Union of Municipal Education Leaders of Ceará (Undime-CE - União dos Dirigentes Municipais de Educação do Ceará). The pilot allowed the identification

of key challenges faced by students in the early grades of primary education while testing methodologies to overcome these challenges and gathering evidence on effective interventions for improving child literacy (SEDUC, 2012).

The TA pilot was developed to ensure that all children would be literate by seven, an ambitious target, particularly with low educational attainment and socioeconomic vulnerability. This initial period was fundamental to understanding the conditions and resources required to reach this goal. The state government teams and their partners closely monitored the children's progress and teachers' performance, using diagnostic assessments and monitoring tools that would later be integrated into the broader program. These assessments also adapted teaching practices, providing a feedback cycle that guided subsequent stages of the program (ALVES, 2010; COELHO, 2013).

The pilot also strengthened the collaborative framework between the state and municipalities, reinforcing that early literacy requires ongoing partnerships across different government and civil society levels. UNICEF's support was essential in establishing this collaborative culture and ensuring each municipality could adapt the program's guidelines and resources to its specific needs. This partnership framework effectively addressed the literacy challenge in a state with considerable regional diversity, becoming one of the cornerstones of *PAIC's* success SEDUC (2016b), SEDUC (2016c).

The pilot's results were promising, showing significant improvements in literacy rates in the participating regions. These improvements prompted the state to expand the program to all 184 municipalities in Ceará beginning in 2007. The pilot demonstrated that significant progress in child literacy was achievable with adequate technical support, ongoing teacher training, and an effective monitoring system. This experimental phase provided data and strategies underpinning *PAIC's* structure and inspired similar educational policies in other Brazilian states (SUMIYA

et al., 2017)

Based on the lessons learned from the pilot, the five main pillars of *PAIC* (literacy, municipal management, children's literature, early childhood education, and external evaluation) were defined, and the program's guidelines were formalized. The pilot's success ensured that these pillars were coordinated and integrated, establishing a solid foundation for the large-scale implementation of the program.

These structural elements allowed *PAIC* to remain flexible and responsive to the specific needs of each municipality, promoting a uniform and high-quality approach to literacy across the entire state of Ceará (SEDUC, 2012). TA's actions were organized into five core pillars, designed to address literacy challenges and strengthen Ceará's educational system:

- **Literacy Pillar:** This pillar focused on the ongoing training of early-grade teachers, providing standardized educational materials and training in reading and writing methodologies. The goal was to ensure that all students completed the second grade of elementary school fully literate. With the support of partners like UNICEF, SEDUC aimed to provide educators with a solid, continuous foundation that enabled them to apply effective pedagogical practices in the classroom (COELHO, 2013).
- **Early Childhood Education Pillar:** This pillar was created to ensure that children had access to an educational environment from an early age, preparing them for the literacy process. It included appropriate educational materials and specialized training for early childhood educators, focusing on developing linguistic and cognitive skills from the first years of schooling (SEDUC, 2012).
- **Children's Literature Pillar:** *PAIC* distributed books and promoted activities that introduced children to literature at an early age to encourage reading habits. Building a culture of reading was central to the program, which included establishing school libraries and organizing playful activities focused

on reading (ALVES, 2010).

- **Municipal Management Pillar:** One of the most innovative pillars, *PAIC* stood out by creating a cooperation policy with municipalities, promoting local networks' autonomy. SEDUC provided technical support so each municipality could adapt the program to meet its specific needs. This included training educational managers and creating quality indicators to monitor and continually adjust *PAIC's* actions, reinforcing shared accountability between the state and municipalities (SEDUC, 2016a).
- **External Evaluation Pillar:** From the beginning, *PAIC* utilized Ceará's Permanent System for Basic Education Evaluation (SPAECE) to monitor student performance. This evaluation system was an essential part of the program, as it allowed for tracking literacy progress in each school and municipality, guiding the development of policies and interventions based on the results (FONSECA, 2013).

In 2008, TA implemented rigorous monitoring of its first cohort of students, using diagnostic assessments to track children's literacy progress. These initial evaluations *(Provinha PAIC)* were fundamental in understanding the program's impact and adjusting pedagogical practices based on each municipality's specific challenges. The monitoring was conducted through the Permanent System for Basic Education Evaluation in Ceará *(Sistema Permanente de Avaliação da Educação Básica do Ceará, SPAECE)*, which gathered detailed data on students' performance in reading, writing, and text interpretation skills, allowing interventions to be precise and effective (ALVES, 2010; COELHO, 2013)

Tracking this first cohort revealed significant improvements in literacy rates. In many municipalities, the proportion of students achieving satisfactory levels in reading and writing increased substantially, indicating that *PAIC's* structure was functioning as planned. These evaluations generated reports that enabled

educators and policymakers to observe both individual and collective student performance, while also building a comprehensive database on child literacy across Ceará. With these data, SEDUC developed customized strategies to support municipalities and address specific deficits detected in each school network (SEDUC, 2012; SEDUC, 2016b).

In addition to student monitoring, the program provided additional training for teachers and administrators based on the assessment results. These training sessions focused on the areas of most significant difficulty identified by the evaluations, ensuring that educators were prepared to address specific challenges found in the classroom. This process helped to consolidate a culture of evaluation and accountability within schools and municipal networks, promoting continuous improvement in teaching quality and student learning (CRUZ *et al.*, 2020). This first cohort also played a crucial role in *PAIC's* model of incentives and recognition.

In 2009, the program introduced the School of Excellence Award *(Prêmio Escola Nota Dez)*, recognizing schools with the best results and promoting motivation and responsibility among administrators and teachers. The awarded schools provided references and inspiration for others, showing that these results were achievable. This system of incentives was essential in strengthening schools' commitment and consolidating the program's success in subsequent years, as *PAIC* expanded its methodology to include more subjects and grades, eventually evolving into *"Mais PAIC"* (SEDUC, 2016b).

The impact of monitoring the first cohort was remarkable and served as a foundation for the program's expansion. With precise data on both progress and challenges, *PAIC* was able to adjust its strategies and improve the support provided to municipalities, establishing a public policy model that prioritized continuous monitoring and adaptation, with a focus on educational equity and quality (SUMIYA *et al.*, 2017). Between 2008 and 2011, TA went through a

consolidation phase and enhancement of its initial practices. After monitoring and analyzing the results from the 2008 cohort, the Ceará government recognized the need to expand and refine some of its strategies to ensure that literacy goals were consistently achieved across the state. This period saw intensified monitoring and evaluation practices and the refinement of teacher and administrator training tailored to the specific challenges observed in each municipal network.

Starting in 2008, with the initial results from the SPAECE diagnostic evaluations, SEDUC gained a clearer picture of the difficulties and advancements in literacy. The assessments revealed regional disparities, highlighting that while some municipalities showed significant improvements, others faced challenges in consolidating literacy practices. To address these issues, TA intensified using SPAECE data to guide more precise and customized pedagogical interventions based on each municipality's specific needs (SEDUC, 2012).

During this period, a detailed reporting system was established, with reports sent to local administrators that included specific recommendations based on the data analysis. This approach fostered a culture of accountability and commitment to results, as each municipality received a clear diagnosis of its main areas of difficulty and the actions needed to address them. This continuous monitoring system became one of *PAIC's* pillars, providing a solid foundation for educational decision-making across the state (ALVES, 2010; SEDUC, 2016b).

Between 2008 and 2011, the continuous training programs for teachers and administrators underwent significant adjustments to meet the needs identified by the assessments. These training sessions began to focus on specific pedagogical practices for literacy, addressing methods that encouraged reading and writing more systematically and effectively. Additionally, training programs for pedagogical coordinators were introduced, enabling them to provide direct support and guidance to teachers in the classroom, ensuring that the recommended practices

were effectively implemented (COELHO, 2013).

This period was also marked by strengthened training for school management. Principals and municipal administrators received training in performance monitoring techniques, enabling them to interpret assessment data and implement more strategic interventions. This investment in educational leadership helped consolidate *PAIC* as a program that provided technical support and empowered local administrators to be active agents in educational transformation within their regions (CRUZ *et al.*, 2020). With the program's initial success, TA began laying the groundwork for a broader scope starting in 2011. At this stage, discussions were underway about including other subjects, such as Mathematics, and expanding the program to cover the later years of elementary education. The experience gained in the program's early years highlighted the importance of consolidating literacy in the first grades and ensuring educational development continuity across all stages of primary education (SEDUC, 2016c).

The period from 2008 to 2011 was crucial for establishing the foundation of what would later become *PAIC +5* in 2011, with the program's expansion to new subjects and educational stages. With a broader vision grounded in data from the early years, TA restructured its actions to ensure that students were literate and maintained their educational progress over the years. Preparing for *PAIC +5* included enhanced training, strengthened monitoring practices, and financial incentives to recognize outstanding schools and municipalities, ensuring that educational quality continued to grow across Ceará (SUMIYA *et al.*, 2017).

Starting in 2015, the program expanded, transforming into what became known as *Mais PAIC*. This phase extended support to students in the final years of elementary school (6th to 9th grades) and incorporated new subjects beyond Portuguese, such as Mathematics and Science. The goal was to ensure that students' academic development was sustainable and reached appropriate proficiency levels in

areas beyond basic literacy. As a result, TA contributed to literacy and the overall improvement of elementary education quality SEDUC (2016b). With this expansion, the program also offered pedagogical support and ongoing teacher training for this stage, in addition to intensifying student performance monitoring, particularly in crucial subjects like Portuguese and Mathematics.

According to Ceará's State Department of Education, this new phase of *Mais PAIC* aimed to prepare students for more complex academic challenges and promote educational equity, ensuring that young people across the state had the opportunity to complete elementary school with essential skills for the job market and higher education (SEDUC, 2016a).

Over the years, *PAIC's* evaluation culture was significantly strengthened. *SPAECE* assessments initially focused on literacy, were refined to include more detailed data and a higher frequency of application. The results were used to measure student performance, guide local educational policy, and adjust pedagogical practices in real time. This focus on continuous evaluation and strategic adaptation helped *PAIC* respond quickly to the needs of each municipality, ensuring that the program's advances were lasting (ALVES, 2010; COELHO, 2013).

With TA's expansion into new teaching stages and subjects, SEDUC's technical support also had to be expanded. Between 2007 and 2017, the program intensified continuous training for teachers and administrators, including specialized training in Mathematics and Science for the upper years of elementary school. School management training was also introduced to equip principals and coordinators to monitor results and implement more effective pedagogical interventions. Technical support included visits from pedagogical consultants to schools, which allowed for closer and more personalized monitoring that addressed each municipality's specific realities.

Another aspect that evolved significantly was the collaborative frame-

work between the state government and municipalities. In 2015, legislation 15,922 was enacted, and the established mechanisms for resource distribution based on educational outcomes were updated. This law allowed a portion of the state's ICMS (Goods and Services Circulation Tax) to be redistributed to municipalities based on school performance in *PAIC* assessments. This financial mechanism incentivized municipalities to invest more in education while reinforcing local administrators' accountability for the program's outcomes (SEDUC, 2016a; SEDUC, 2015).

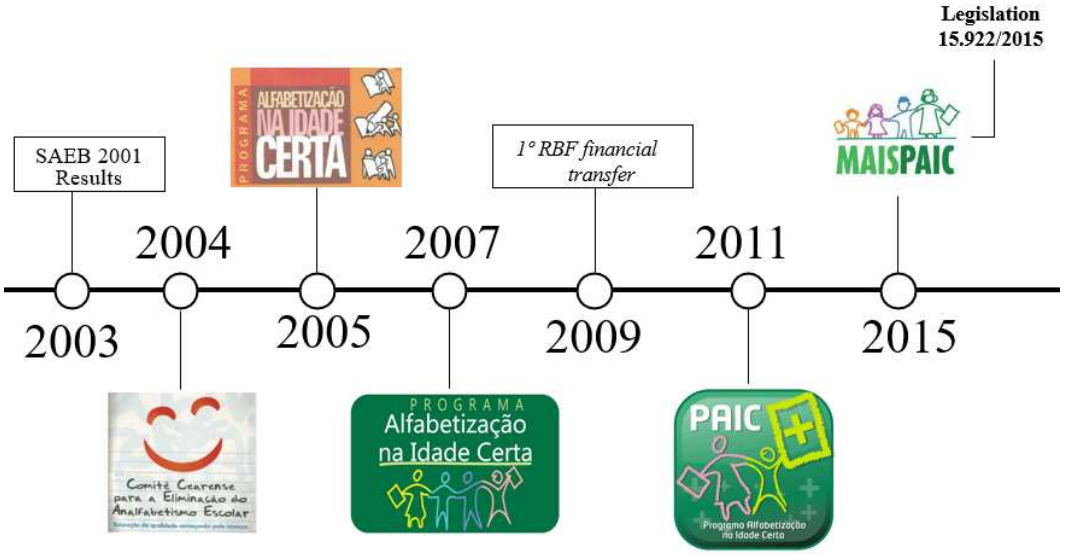
The changes and innovations implemented in TA between 2007 and 2017 helped establish it as a public educational policy model, attracting the attention of other Brazilian states. The improvements in literacy rates and student performance in Ceará, particularly in areas with high rates of social vulnerability, were significant and inspired the implementation of similar programs in other regions. In 2012, the federal government launched the National Pact for Literacy at the Right Age *(Pacto Nacional pela Alfabetização na Idade Certa, PNAIC)*, an initiative inspired by the *PAIC* model to promote literacy on a national scale (COSTA; CARNOY, 2015).

The continuous transformations of TA between 2007 and 2017 demonstrated the program's ability to adapt to the state's educational needs, staying relevant to the challenges of each stage while expanding its scope progressively and strategically. With a strengthened collaborative framework, an ingrained culture of assessment, and incentives for quality, TA has become a successful example of public education policy, promoting equity and improving access to quality education in Ceará (SUMIYA *et al.*, 2017).

In summary, the TA centered on management, focused on student learning, and emphasized changing the municipal and school management culture. The TA initially targeted literacy for second-grade students, and in 2011, it expanded to include and support grades 3 to 5; in 2015, it expanded again to include grades

6 to 9. Figure 1 presents the timeline of the TA evolution over the years.

Figure 1 – Technical Assistance Program Timeline



Note: Figure 6 illustrates the evolution of TA from its beginnings as a pilot project to its consolidation and expansion as a state public policy and a reference in literacy.

The RBF with technical assistance was feasible due to the decentralized primary and lower secondary education management structure. This decentralization allows municipalities to establish policies across various sectors, including education, as long as they align with national and state regulations. It also places full responsibility for school management on the municipal education secretariat, covering hiring, firing, staff professional development, and building maintenance. According to the annual education census, in 2007, 77% of enrollments in Ceará were in municipal schools, compared to 42% nationwide. By 2018, these figures had risen to 96% in Ceará and 50.5% in Brazil. The decision to delegate the management of primary and lower secondary education to municipalities established clear roles and responsibilities at each level of government.

Measuring results plays a key role in establishing an RBF system and

identifying municipalities that need additional support. To accomplish this, the State Government partnered with municipalities to develop a robust and reliable monitoring and evaluation system that continuously assesses educational outcomes in all public schools. This system diagnoses students' proficiency levels and helps set performance goals, while training and monitoring initiatives support teachers and schools in reaching these targets. Together, these four components cultivate a culture where continuous feedback drives system-wide improvement and reinforces a shared commitment to educational quality.

Empirical evidence suggests that such policies improve student performance (SHIRASU *et al.*, 2013a; PETTERINI; IRFFI, 2013; BRANDÃO, 2014a; CARNEIRO; IRFFI, 2018; SILVA, 2021; IRFFI *et al.*, 2021; CARNEIRO *et al.*, 2022). However, a limitation in part of this literature is the lack of controls for policies implemented simultaneously with the RBF. In Ceará's case, a crucial program that could confound the results is the TA. Glewwe e Muralidharan (2016) demonstrates that the combination of performance-based spending policies and incentives for effective implementation can account for most of the observed outcomes.

2.3 Data and Econometric Strategy

2.3.1 Data

This study evaluates the impact of good management practices in municipalities' schools at the frontier of Ceará versus municipalities' schools at the border of Ceará. In this way, we use several sources of data information.

Our primary data source is the National Basic Education Assessment System (*Sistema de Avaliação da Educação Básica, SAEB*), provided by the Anísio Teixeira National Institute for Educational Studies and Research (*Instituto Nacional de Estudos e Pesquisas Educacionais Anísio Teixeira*, INEP), covering the years

2007 to 2017. The *Prova Brasil/SAEB* is a national assessment of learning quality administered in public schools every two years.

The exam provides standard test scores in mathematics and language and collects detailed information about students, teachers, and school principals. We are interested in those questionnaires to compute the School Management Quality Index (SMQI). A detailed list of questions used to construct the index is available in Table B3.11.

We used the Pereira e Goncalves (2024) (geobr), a package for R that provides public domain geospatial data in a simple-to-use way [5] that allowed us to obtain detailed information about the exact location of schools across Ceará and its neighboring states. This package was also critical in figuring out Ceará's border with its neighboring states, which allows us to use meaningful spatial representation for our analysis. The geobr package is helpful because it focuses on providing high-quality official spatial data in Brazil.

We also utilized the Brazilian National Educational Census, collected by INEP, to gather data on school inputs (such as class size, teacher-student ratio, teacher gender, race, and education level, number of enrollments, and school infrastructure) as well as student characteristics (gender, race, age)[6]. In this dataset, schools are uniquely identified by an 8-digit code, and students by a 12-digit code, commonly referred to as INEP codes. The characteristics from 2007 were used to calculate weights for adjusting the attributes of schools with SMQI scores above or below the median through the entropy balancing method, as described by Hainmueller (2012), enabling comparisons between schools with similar characteristics before treatment.

Similar to Lautharte *et al.* (2021), we limit our sample to schools located

[5] The R package allows us to avoid the need for spatial SQL queries and the manual manipulation of shapefiles, streamlining the process of handling and analyzing geospatial data.

[6] A describe table of this variables are in Table A3.1

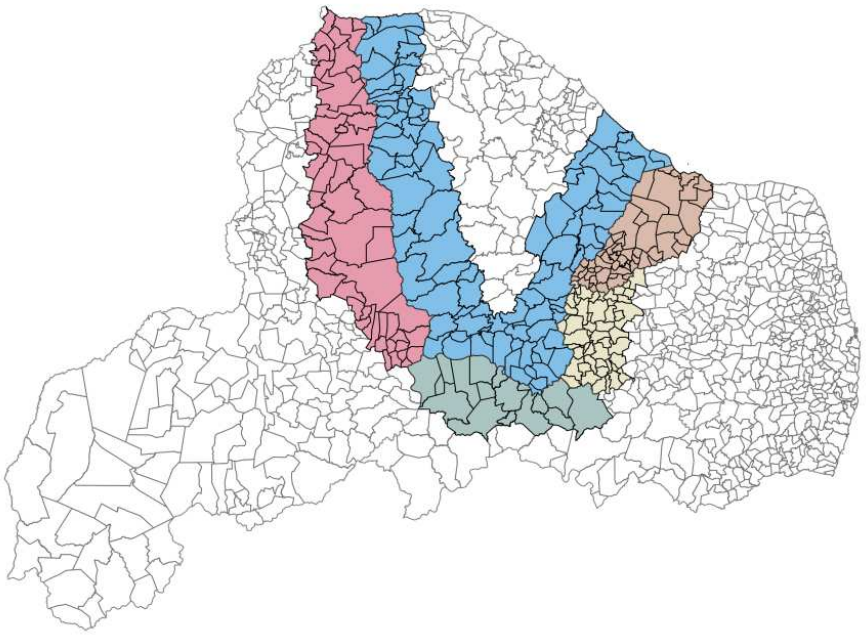
within the three municipalities closest to the border on each side between Ceará and the neighboring states, i.e, schools located in Ceará and neighboring states: Piauí, Rio Grande do Norte, Paraíba, and Pernambuco[7]. Figure 2 illustrates the schools included in the analysis. This geographical restriction helps minimize the influence of time-invariant, unobserved characteristics of schools and municipalities that could affect student learning outcomes.

Additionally, it assists in determining the optimal bandwidth for our RDD model. Schools located just across the border serve as a strong counterfactual for assessing what would have occurred in the absence of the RBF reform in Ceará. Our school data is structured as an unbalanced panel, covering the years when the *Prova Brasil/SAEB* was conducted between 2007 and 2017[8].

[7] In Pernambuco, until 2011, tax value-added and conservation units were also considered in the distribution formula. From 2011 onward, 2% of the *Quota-Parte* was distributed to municipalities based on educational quality. More recently, legislation 16.616/2019 increased this share to 18% by 2025, as in Ceará. Although Pernambuco adopted a similar results-based financing mechanism and Carneiro *et al.* (2022) find positive results. Excluding Pernambuco from our estimates does not significantly affect the interpretation of the results

[8] Due to changes in the questionnaires after 2017, it became impossible to reproduce the SQMI Index

Figure 2 – Schools and Municipalities used in our database



Note: In Figure 2, we present the municipalities included in our sample. The schools in municipalities to the treatment group are represented in blue, while the schools belonging to the control group are depicted in different colors, depending on the state. This color coding visually differentiates the two groups, allowing for a clear comparison between the treatment and control units within the sample. Municipalities in white are not used in our sample.

2.3.1.1 Measuring school management practices

Assessing the quality of public management poses notable challenges due to the complex interplay of factors influencing managerial efficiency and the latent nature of management quality. One widely accepted method to overcome these challenges involves evaluating specific management practices. These practices, endorsed by experts and consultants, are believed to have a causal link to organizational performance (HWA; LEAVER, 2021). A prominent example of this approach is the World Management Survey (WMS), a framework designed by Bloom *et al.* (2015) to measure management quality across various contexts. In this methodology, adopting a higher number of recommended practices is considered

indicative of superior management quality.

While this approach has notable strengths, such as ease of measurement and the ability to capture how practices are implemented rather than their mere presence, it is not without limitations. For instance, practices like conducting performance assessments are widely regarded as beneficial in education. However, if the results are not used to implement strategies that improve learning, the mere act of assessment may have little value. Additionally, the WMS methodology is resource-intensive, making it difficult to scale for analyzing the extensive number of public schools in Brazil.

Attempts to adapt similar methods in Brazil have been limited in scope, covering only a small number of schools within specific municipalities (BORGES *et al.*, 2024; HOOGERBRUGGE, 2019). To address these constraints, Leaver *et al.* (2019), Leaver *et al.* (2022) developed a school management index derived from Prova Brasil data. This index harmonizes responses from the Prova Brasil questionnaires (2007–2017) completed by school directors, teachers, and students. The data is consolidated into a student-level dataset covering grades 5 and 9, which is then aggregated at the school-grade level for analysis.

Following Leaver *et al.* (2019), Leaver *et al.* (2022), we used a structured process to build the management index. First, 29 questions from the combined Prova Brasil/SAEB dataset were classified into seven categories that align with the WMS topics. Second, these questions were assigned normalized scores (0 to 1) based on the WMS scoring methodology, where more structured practices received higher scores. Third, an average score was calculated for each of the five topics using the relevant questions. These topic-specific scores were standardized based on their within-year distributions.

The overall school-level management index and topic-specific indices were computed using the method described by Anderson (2008). This approach

assigns weights to variables based on their informational contribution, emphasizing those that add unique insights while minimizing the influence of redundant data. Scores are expressed in standardized deviations (SDs), ranging from 0 to 1.

Although the *Prova Brasil/SAEB-based* School Quality Management Index (SQMI) does not cover all topics from the original WMS survey, Leaver *et al.* (2019), Leaver *et al.* (2022) validated its reliability by comparing it to the WMS index for 273 Brazilian schools in 2013, finding a strong correlation between the measures. For this study, we utilized the SQMI from 2007 to assess the quality of school management prior to Ceará's educational reform. A detailed list of variables used by Leaver *et al.* (2019), Leaver *et al.* (2022) can be found in Table A3.21 in appendix.

2.3.2 Empirical strategy

Identifying the impact of implementing TA and the RBF mechanism in Ceará is challenging for good management practice. To measure the causal impact of these programs, we implemented the regression discontinuity (RD) strategy following Calonico *et al.* (2014), Calonico *et al.* (2015), Cunningham (2021). We also use a spatial regression discontinuity (SRD) strategy following Keele e Titiunik (2015), Lehner (2024a) to capture the heterogeneity across distance (uni-dimensional) and in different points (two-dimensional) of the Ceará borders.

2.3.2.1 The Regression Discontinuity Design

An RD design has three essential components: a score (or running variable), a cutoff, and a treatment assign rule. The score X_i determines whether a unit $i = 1, 2, ..., n$ is treated based on whether it exceeds a pre-determined cutoff c. The treatment is assigned as follows:

$$D_i = 1(X_i \geq c)$$

Where D_i is the treatment indicator, and $1(X_i \geq c)$ is an indicator function that equals one if the score exceeds the cutoff and zero otherwise. Each unit has two potential outcomes: $Y_i(0)$, if untreated, and $Y_i(1)$ if treatment. Since we only observe one of these outcomes, the observed outcome Y_i is:

$$Y_i = f(X_i) + \varepsilon_i$$

Where $f(X_i) = (1 - D_i) \cdot Y_i(0) + D_i \cdot Y_i(1)$. We are interested in estimating the local average treatment effect (LATE) at the cutoff in RD design. If the expect values of $Y_i(0)$ and $Y_i(1)$ are continuous at $X = c$, the treatment effect at $X = c$ is:

$$\tau_{\text{RD}} = \mathbb{E}[Y_i(1) - Y_i(0) \mid X_i = c] = \lim_{x \downarrow c} \mathbb{E}[Y_i \mid X_i = x] - \lim_{x \uparrow c} \mathbb{E}[Y_i \mid X_i = x]$$

The equation above implies that the treatment effect can be estimated by comparing the expected outcomes for units just above or below the cutoff. A central goal of the RD analysis is to adequately perform extrapolation to compare the control and treatment units Cattaneo *et al.* (2019). To estimate the τ_{RD} in our model, we can use the following regression:

$$Y_{imst} = \beta_0 + \beta_1 School_{imst} + f(SchoolMargin_{imst}) + X'_{imst} + \varepsilon_{imst} \tag{2.4}$$

Where Y_{imst} is the school management variable in school i, municipality m, state s, and t represents that outcome variables are measured in the year of SQMI measurement. In addition, $SchoolMargin_{imst}$ is a continuous variable representing the cutoff distance, in our case, the distance to the Ceará border. Positive values of $SchoolMargin_{imst}$ indicate that the school is in a municipality in Ceará in year t, and negative values suggest that the school is in municipalities in border states of Ceará in year t. The parameter of interest is β_1, which indicates the effect of

a school in Ceará on the management practice. Therefore, $School_{imst}$ is a binary variable that takes values one if $SchoolMargin_{imst} > 0$ and zero; otherwise, X'_{imst} is a vector of covariates in 2007, pre-educational reform in Ceará. Pre-treatment Covariates are not necessary for identification, but they can improve estimates' precision when included in RD regression (LEE, 2008; IMBENS; LEMIEUX, 2008). In addition, we estimate the standard errors by clustering at the municipal level.

We conducted this estimation for each SAEB exam from 2007 to 2017 to analyze the impact of the educational reform in Ceará, which was implemented after 2007. By including the year previous to the reform, we establish a baseline for comparison, allowing us to measure any changes in student performance that can be attributed to the reform. The subsequent years (2009–2017) help us capture the evolution of these effects over time, providing a more comprehensive understanding of how the reform influenced educational outcomes in Ceará.

Our main estimation, however, focuses on grouping the schools between 2011 and 2017. This specification allows us to evaluate the reform's sustained impact during its full implementation, providing insights into its long-term effects on school performance after the initial implementation phase.

2.3.2.2 The Spatial Regression Discontinuity Design

Since we implemented a geographic setup in our baseline RD framework, setting some information about SRD is essential. Since we are working with coordinates, we use EPSG geodetic parameter dataset *4676*, designed for Latin America and is the official projection used by IBGE. Because most spatial RDDs are carried out over relatively confined geographic spaces, this is less of a concern if an appropriate projection has been selected[9].

[9] A discussion about coordinates system can be found in Pebesma e Bivand (2023), Lehner (2024a)

The uni-dimensional specification is widely adopted for an SRD estimation, treating the distance to the RD boundary as a uni-dimensional score similar to traditional RD design, Cattaneo *et al.* (2024) refer this estimation as normalized-and-pooled treatment effects. The score for each observation i is calculated as

$$\text{dist}_i = d(x_i, \mathscr{B}) \tag{2.5}$$

Where the $d(x_i, \mathscr{B})$ represents the shortest distance between point x_i the boundary $\mathscr{B}$, and the treatment is assigned when the distance is non-negative, leading to a cutoff value of $c = 0$. To ensure that we are comparing only units nearby, we split the cutoff into several different segments, $\mathscr{B} = \bigcup_{s=1}^{S} \mathscr{B}_s$. Then, for every point x_i, we compute which segment is closest, $\arg\min_s d(x_i, \mathscr{B}_s)$. The resulting categorical variable is then used to create a border segment fixed effect. The researchers use the resulting categorical variable to generate border segment fixed effects, ensuring that the analysis captures only variation within each segment and avoids comparisons between geographically distant units. Visualizing these border segments on a map ensures transparency and clarity. The researchers create the segments using the SpatialRDD package Lehner (2024a)[10]. They then modify the estimating equation as follows:

$$Y_{imst} = \beta_0 + \beta_1 School_{imst} + f(SchoolMargin_{imst}) + \sum_{s=1}^{S} \gamma_b segs_{imst}^{s} + X'_{imst} + \varepsilon_{imst} \tag{2.6}$$

Where the variable $segs_i^s$ equal one if unit $imst$ is closest to segment $\mathscr{B}_s$ and zero otherwise. X'_{imst} is a vector of covariates in 2007; these controls, however, should not be used to correct for a discontinuity in an important pre-treatment covariate - i.e., to restore the validity of the design Cattaneo *et al.* (2019).

[10] The generated segments can be seen in Appendix 1 – Border Segments

A spatial regression discontinuity design represents a specific case of a multi-score RDD in which the treatment assignment depends on the spatial location of units. In this two-dimensional framework, researchers assign treatment based on whether a unit falls within a defined geographic boundary. This approach contrasts with traditional one-dimensional RD designs that rely on a single scalar cutoff; instead, the spatial RD uses a geographic boundary as the cutoff.

Border discontinuity designs, however, allow the identify a wider set of parameters by estimating an effect along the treatment boundary (IMBENS; ZAJONC, 2011; ZAJONC, 2012). In our set, we follow Lehner (2023) two-dimensional design that uses Monte Carlo simulations to capture the treatment effect along the boundary. The RD treatment effect at every point point b_b on $\mathscr{B}_s$) can be write as:

$$\tau_{BRD}(b_b) = \mathbb{E}[Y_i(1) - Y_i(0) \mid X = b] \tag{2.7}$$

A boundary-wide treatment effect, $\tau_{BRD}(b_b)$, can be obtained by taking the expectation over the whole boundary. Using the approach outlined for the traditional case, we can estimate the treatment effect by (locally) extrapolating at every boundary point.

$$\tau_{BRD}(b_b) = \lim_{X \to b_b} \mathbb{E}[Y_i \mid X \in N^t_{h_b}(b_b)] - \lim_{X \to b_b} \mathbb{E}[Y_i \mid X \in N^c_{h_b}(b_b)] \tag{2.8}$$

Where $N^t_{h_b}(b_b) \equiv N_{h_b}(b_b) \cap \mathscr{P}_t$ is the neighborhood of points that receive treatment, and $N^c_{h_b}(bb) \equiv N_{h_b}(bb) \cap \mathscr{P}_c$ is the neighborhood of points that are in the control group. In addition to the continuity assumption, we must also impose a boundary positivity assumption (IMBENS; ZAJONC, 2011). This ensures that treated and untreated units are at every point along the boundary. To obtain the boundary-wide treatment effect, rather than integrating over the entire boundary, we can approximate it using:

$$\hat{\tau}_{BRD} = \frac{\sum_{b=1}^{B} \hat{\tau}_{BRD}(b_b) w_b}{\sum_{b=1}^{B} w_b} \tag{2.9}$$

As the number of boundary points increases, this approximation converges to an integral. Estimating multiple RD coefficients along the boundary is valuable for two key reasons. First, it allows researchers to explore potential heterogeneity in treatment effects, providing deeper insights into the research question. For instance, the RD effect might be concentrated in specific segments along the boundary, while no effect is observed in other areas.

Understanding why the effect occurs in some regions and not in others can help identify the mechanisms driving the treatment and determine if any mediating factors are involved. Second, a two-dimensional estimation is useful purely for visual representation, enhancing the clarity and interpretation of results. In our estimation, we use equation (2.9), using the Ceará border as a boundary and school geolocation as units. We choose 40 equally spaced points

2.3.2.3 Validity of Empirical strategy

For the RD design to be a valid method, two fundamental conditions must be fulfilled. The first is the continuity hypothesis, which essentially requires that, without the treatment, the outcomes for the group receiving the treatment would have been similar to those of the control group.

We employed several regression analyses within the RDD framework to address this potential bias. This analysis involved incorporating a set of predetermined variables that capture education-related municipal conditions. By doing so, we ensured that any observed treatment effect on school management is not confounded by other factors varying around the border threshold. We present the estimates in Figure A2.2, using our baseline covariates as the dependent variables in

Equation 2.6. The results indicate that all baseline characteristics are well-balanced, meaning there are no significant differences between the treated and control groups regarding these covariates. For a more detailed breakdown of these estimations, please refer to Table A3.4, A3.5,A3.6, which reports the complete results.

The second condition for validating the RD estimation is using McCrary's test. This test assesses whether the distribution of the running variable (in this case, the margin of distance to Ceará border) is smooth around the threshold, thereby ensuring the absence of manipulation of the individuals around the treatment threshold. If manipulation were present, we would observe a sharp change in the density of observations at the cutoff point, which would invalidate the RD approach. The results of the McCrary test are shown in Table 1. The results suggest no manipulation of the border threshold. We replicate McCrary's test for each SAEB year separately and find no evidence of manipulation in any year, confirming the integrity of the RD design [11].

The RDD analysis offers valuable insights into the reform's impact, but researchers must also acknowledge its limitations in capturing the timing of effects. In this study, the RDD framework estimates the reform's impact from 2007 to 2017. Although this approach effectively identifies causal effects near the cutoff, it may miss early responses to the policy or delayed adaptations that unfold over time. While the findings provide strong evidence of the reform's effectiveness, researchers should interpret them cautiously, especially when considering the immediacy or progression of the impacts. This underscores the importance of situating the RDD results within the broader policy implementation timeline and examining potential

[11] In appendix table A3.7 present a detailed overview if there were any changes in student composition across four states (Piauí - PI, Ceará - CE, Rio Grande do Norte - RN, and Paraíba - PB) from 2007 to 2017. It tracks the percentage of students living in the city where they were born, studying in the city where they live, and studying in the same state where they live. Figure A2.1 presents the mccray test indicating no discontinuity at the cutoff, from 2007 to 2017.

interactions with other concurrent developments.

2.4 Results

This section analyzes the estimated impact of the TA program and the RBF mechanism on the school management index over multiple years. To rigorously assess these effects, we present results from the conventional Regression Discontinuity Design (RDD) and the Spatial RDD. The following sections describe these methodologies and report the findings, enabling us to evaluate the consistency and spatial relevance of the observed impacts.

We conduct a series of robustness checks to strengthen the credibility and robustness of our conclusions. These include placebo tests designed to ensure that the estimated effects are not driven by random variation or external factors unrelated to the TA program or the RBF mechanism. Finally, we investigate several potential mechanisms that may explain how and why these interventions influence the school management index, providing deeper insight into the processes underlying the observed outcomes.

2.4.1 Unidimensional Specifications

Table 1 presents the regression discontinuity estimation for the SQMI in schools near the Ceará border over the years. Since the SQMI data is available for the SAEB assessments from 2007 to 2017, we focused our analysis on these years. As a main result, we aggregated the school index from 2011 to 2017 to assess the impact of the TA program and RBF mechanism after their full implementation. It is essential to highlight that in 2011, the first cohort of TA appeared in the SAEB application, and the TA program was expanded to 3rd to 5th grade. Table 1 displays the results in seven columns for three panels.

Panels A, B, and C display the results from the linear, quadratic, and cubic specifications, respectively. Column (1) estimates the overall impact of the TA program and the RBF mechanism on the school management index during 2011–2017. Columns (2) through (7) present yearly estimates from 2007 to 2017. We estimate all specifications using control characteristics and apply weights based on entropy balancing[12]. Incorporating covariates in the RDD models enhances precision by reducing unexplained variability and addressing baseline imbalances. This approach improves estimation accuracy, bolsters robustness, and facilitates the identification of heterogeneous effects across subgroups. Although not strictly necessary for identification, including covariates increases the model's efficiency and confirms that the results are not driven by omitted variable bias. All specifications assume a linear trajectory on both sides of the cutoff.

Calonico *et al.* (2014) method is used to choose the optimal bandwidth and estimate the results in all columns. In addition to the discontinuity regression estimates[13], Table 1 reports the robust p-value, the robust confidence interval, the CCT optimal bandwidth, the effective number of observations used in the estimation, and the robust p-value of the Mccray test. We cluster the standard errors using municipalities.

The SQMI is measured in terms of standard deviation. As a result, the estimation presented in Table 1 suggests that schools in Ceará that received the TA program and RBF mechanism increase by 0.012 SDs in SQMI, according to the specification in Panel A, column (1), suggesting that improved management practices were associated with the education reform in Ceará. However, the estimates reveal some heterogeneity across years. In 2009, the results showed a significant negative effect. During that year, the TA program was implemented

[12] We implemented the entropy balancing method proposed by Hainmueller (2012) to adjust control variables using 2007 data, before the educational reform in Ceará

[13] In appendix table A3.8 fixed the optimal bandwidth for all estimation using the period of 2011 to 2017

only in the second grade, and it marked the first year of the RBF cash transfer, which was still in its initial phase. In contrast, 2011 displays a significant positive effect, reflecting the point at which the first cohort of TA students participated in the SAEB exam, and the RBF mechanism had become more established and consolidated.

Panels B and C provide further insights into the variability of the policy impacts. The results in column (1) for Panel B continue to be significant at 5% and decrease to 0.011 SDs, and for Panel C, the results are only significant at 10%. Across all specifications, the McCrary test confirms the validity of the RDD approach, as no manipulation of the cutoff variable was detected.

Table 1 – RDD estimation - Results for Linear, Quadratic, and Cubic Specifications across different years

	11-17	07	09	11	13	15	17
Panel A: Linear Specification							
Rd Estimator	0.012	0.003	-0.017	0.012	-0.014	0.023	0.020
Robust p-value	0.004**	0.855	0.083*	0.04**	0.240	0.169	0.084*
Robust conf. Int.	[0.004, 0.020]	[-0.030, 0.036]	[-0.037, 0.002]	[0.001, 0.024]	[-0.037, 0.009]	[-0.010, 0.055]	[-0.003, 0.044]
CCT-Optimal BW	32.23	29.294	27.246	43.193	27.365	41.487	28.932
Eff. Number Obs	2856	400	473	974	457	832	800
Mccray test (robust p-value)	0.1514	0.2688	0.271	0.1502	0.2484	0.3288	0.4564
Panel B: Quadratic Specification							
Rd Estimator	0.011	0.009	-0.016	0.013	-0.026	0.017	0.023
Robust p-value	0.035**	0.645	0.213	0.077*	0.060*	0.451	0.153
Robust conf. Int.	[0.001, 0.021]	[-0.028, 0.045]	[-0.040, 0.009]	[-0.001, 0.027]	[-0.054, 0.001]	[-0.027, 0.060]	[-0.009, 0.056]
CCT-Optimal BW	38.846	41.572	40.764	43.282	33.108	44.815	43.093
Eff. Number Obs	3508	589	806	976	610	904	1216
Mccray test (robust p-value)	0.1514	0.2688	0.271	0.1502	0.2484	0.3288	0.4564
Panel C: Cubic Specification							
Rd Estimator	0.009	0.011	-0.015	0.016	-0.035	0.010	0.037
Robust p-value	0.076*	0.574	0.292	0.052*	0.019**	0.693	0.041**
Robust conf. Int.	[-0.001, 0.020]	[-0.027, 0.049]	[-0.044, 0.013]	[-0.000, 0.032]	[-0.065, -0.006]	[-0.041, 0.061]	[0.001, 0.072]
CCT-Optimal BW	53.668	59.335	52.702	53.736	48.218	52.578	47.689
Eff. Number Obs	4729	838	1025	1178	908	1066	1351
Mccray test (robust p-value)	0.1514	0.2688	0.271	0.1502	0.2484	0.3288	0.4564

Note: *** denotes significance at 1 percent, ** at 5 percent, and * at 10 percent level. Table 1 reports source RD estimates of the effect of schools in Ceará on the School Management Quality Index (SQMI), considering 2007 to 2017. Panel A shows the linear specification, Panel B the quadratic specification, and Panel C the cubic specification. Optimal bandwidths following (CALONICO *et al.*, 2014). We include weighted control variables. We report robust-bias corrected p-values. The estimation used control variables. By choice, the authors decided to omit the results. Standard errors are clustered by municipality.

The variations observed in the estimated effects across years likely reflect the TA program's phased implementation and ongoing adjustments. In

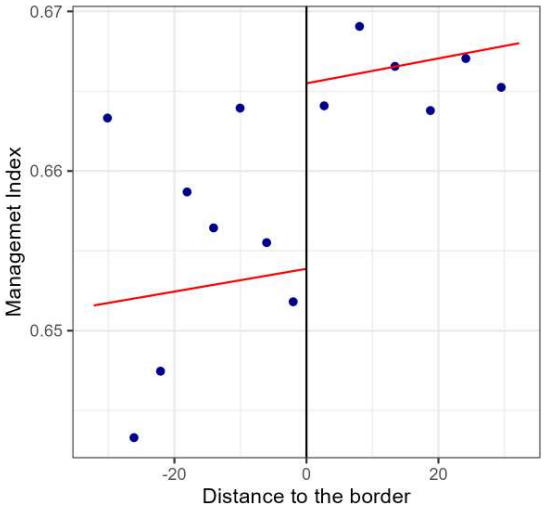
2009, the analysis revealed negative effects, which coincided with the program's early implementation phase—when TA support was restricted to second grade and introduced alongside the initial rollout of the RBF mechanism. These early years likely captured transitional challenges and limited program coverage, resulting in weaker outcomes.

In contrast, the significant positive effects observed in 2011 align with the completion of the SAEB assessment by the first cohort of TA-supported students and the program's expansion to include grades 3 through 5. By this point, the RBF mechanism had also reached a more consolidated phase, enabling schools to use the financial incentives and technical assistance provided effectively.

The gradual improvements in SQMI over time suggest that the incremental expansion and refinement of the TA program played a key role in strengthening school management practices. This pattern highlights the importance of accounting for the evolving nature of policy implementation when interpreting the results. While early years may reflect initial adaptation challenges, later years illustrate the program's maturity and full potential to drive meaningful change.

Figure 3 shows graphically the effects described above for linear specification. We present the RD plot for the impact of Ceará schools on SQMI for municipal schools from 2011 to 2017, displaying a larger discontinuity around the cutoff. Note that the values to the right of zero are smaller (Distance to Ceará's Border in Border states municipal schools) than those to the left (Distance to Ceará's Border in Ceará municipal schools). These findings, especially for the whole period (2011 to 2017), underscore the impact of SQMI in Ceará municipal schools near the cutoff. These results indicate that enhanced management practices significantly improved SQMI outcomes during this period. The consistency across different specifications reinforces the validity of the analysis and emphasizes the crucial role of effective school management in driving better educational performance.

Figure 3 – Impact of Ceará schools on SQMI for municipal schools from 2011 to 2017



Note: Figure 3 shows graphically the effects impact of Ceará schools on SQMI for municipal schools from 2011 to 2017 for linear specification. Binselect for this plot is an ES - IMSE-optimal evenly-spaced method using spacings estimators.

2.4.2 Unidimensional Specifications with boundary segments

In this section, we examine the heterogeneous impact of the TA program and RBF mechanism on the SQMI of municipal schools in Ceará from 2011 to 2017, using geographic border segments as fixed effects and varying distances to the cutoff.

We group schools into boundary segment categories to ensure that the analysis compares only nearby observations. These segments enable a within estimator, which controls for unobserved heterogeneity by allowing different intercepts across segments. Alternatively, instead of applying the within transformation, we include dummy variables for each segment in the regression. This method produces a saturated model in which the main regression coefficient reflects a weighted aver-

age of treatment effects across all segments. Moreover, by analyzing the individual coefficients for each segment, we can investigate potential heterogeneity in the treatment effect and gain deeper insights into how the impact of the policy varies along the geographic discontinuity.

We use the equation (2.6), using control variables and three different sets of boundary segment fixed effects to capture geographic heterogeneity and ensure that we only compare schools close to each other, the standalone of the municipality. This method, popularized by Dell (2010) and Keele e Titiunik (2015), examines only observations within a certain distance around the border by using a parametric approach.

Table 2 presents the parametric specification of our main results that use schools from 2011 to 2017 using the segments we created as fixed-effect. In Panel A, we have the parametric specification without a defined distance to cutoff, i.e., we estimate the total sample using the different segments and years as fixed effects. In column (1), with five segments, the estimation suggests that schools in Ceará that received the TA program and RBF mechanism increased by 0.019 SDs in SQMI, in column (2), an increase of 0.020 SDs in the school management index, and in column (3) an increase of 0.021 SDs in SQMI. All three results use weighted variables as controls, and the standard errors were clustered by municipality. The results on Panel A point out a more significant result when compared to results in Table 1.

Unlike panel A, panel B restricts the sample to what is defined in Table 1 for our principal estimation, i.e., a sample with schools within 32.23 km of the cutoff. The results are positive and significant, ranging from 0.009 to 0.010 SDs. As compared to the classic RD estimation in Table 1 that we obtained from the non-parametric local linear regression from (CALONICO *et al.*, 2014), the point estimate from our fixed-effects regression is slightly lower, reflecting a more

conservative assessment. These results suggest that the treatment effect remains robust even with optimized model adjustments. The results across both panels show the effectiveness of improved school management practices and their scalability across varying parametric approaches. The significant treatment effects highlight the role of management interventions in enhancing SQMI, providing robust evidence for the importance of education policy reforms.

Table 2 – Parametric Specifications

PANEL A: Parametric Specifications			
	(1)	(2)	(3)
Treated	0.019***	0.020***	0.021***
	(0.004)	(0.004)	(0.004)
Num.Obs.	8072	8072	8072
R2 Adj.	0.049	0.052	0.059
Covs	Y	Y	Y
Segment	05	10	15
Cluster	Segment	Segment	Segment
F.E	Year + Segment	Year + Segment	Year + Segment
PANEL B: Parametric Specifications with RDD CCT-Optimal BW			
	(1)	(2)	(3)
Treated	0.009**	0.010**	0.009**
	(0.003)	(0.003)	(0.003)
Num.Obs.	3330	3330	3330
R2 Adj.	0.035	0.042	0.052
Covs	Y	Y	Y
Segment	05	10	15
Cluster	Segment	Segment	Segment
F.E	Year + Segment	Year + Segment	Year + Segment

Note: *** denotes significance at 1 percent, ** at 5 percent, and * at 10 percent level. Table 2 uses a parametric specification to estimate the results. In Panel A, we use the full sample; in Panel B, we restrict our sample to the Optimal bandwidth from the non-parametric local linear regression from (CALONICO *et al.*, 2014). We use weighted control variables, segment, and year fixed effect. Standard errors in parentheses are clustered by municipality.

To assess the sensitivity of the parametric model to choose optimal bandwidth in (CALONICO *et al.*, 2014) model, we tested different sample restrictions by varying the distance from the cutoff. Table 3 points out the results with

40, 60, and 100 kilometers of distance to Ceará's border. Panels A to C, all the results are significant at 5%. In column 1, using the five segments fixed effect, the treated effect grows from 0.009 SDs, a result similar to the one presented in Table 2, panel A up to 0.017 SDs, similar to point out in Panel A in Table 2.

In Column 2, we use the ten-segment fixed effects; the treated effect also starts at 0.011 SD in Panel A, increasing to 0.018 SD in Panel C, demonstrating consistent and stable effects as the distance expands. In Column 3, using fifteen-segment fixed effects, the treated effect follows the same upward trend, rising from 0.010 SD in Panel A to 0.019 SD in Panel C. These results indicate that the larger the geographic scope, the more robust the effect becomes. The significance across columns reflects that management reforms yield more substantial and statistically reliable effects as the analysis covers broader distances, reinforcing the scalability and effectiveness of the interventions.

The differences observed in the results tend to widen as the analysis includes schools farther from the border. Two main factors help explain this pattern. First, regions farther from the border tend to have a larger number of schools, which expands the sample size and increases both the variability and the statistical robustness of the estimated effects. Second, these areas often correspond to more urbanized cities with higher population density and better socioeconomic conditions, which can positively influence school management practices and educational outcomes.

These findings suggest that distance from the border is not merely a geographical characteristic. Instead, it is closely associated with structural differences in regional development that directly shape the implementation and effectiveness of educational policies. Therefore, it is essential to interpret the variation in estimated effects through the lens of broader contextual and socioeconomic factors, which may amplify or mediate the observed policy impacts.

Table 3 – Parametric Specifications - Different Cutoff Distance

Panel A: Parametric Specifications with 40km distance			
	(1)	(2)	(3)
Treated	0.009**	0.011**	0.010**
	(0.004)	(0.004)	(0.004)
Num. Obs.	3593	3593	3593
R2 Adj.	0.033	0.041	0.052
Covs	Y	Y	Y
Segment	05	10	15
Cluster	Segment	Segment	Segment
F.E	Year + Segment	Year + Segment	Year + Segment
Panel B: Parametric Specifications with 60km distance			
	(1)	(2)	(3)
Treated	0.013**	0.014**	0.015***
	(0.003)	(0.004)	(0.004)
Num. Obs.	5031	5031	5031
R2 Adj.	0.039	0.044	0.053
Covs	Y	Y	Y
Segment	05	10	15
Cluster	Segment	Segment	Segment
F.E	Year + Segment	Year + Segment	Year + Segment
Panel C: Parametric Specifications with 100km distance			
	(1)	(2)	(3)
Treated	0.017**	0.018***	0.019***
	(0.004)	(0.005)	(0.004)
Num. Obs.	6777	6777	6777
R2 Adj.	0.049	0.052	0.061
Covs	Y	Y	Y
Segment	05	10	15
Cluster	Segment	Segment	Segment
F.E	Year + Segment	Year + Segment	Year + Segment

Note: *** denotes significance at 1 percent, ** at 5 percent, and * at 10 percent level. Table 3 uses a parametric specification to estimate the results. In Panels A to C, we tested different sample restrictions by varying the distance from the cutoff. We use weighted control variables, segment, and year fixed effect. Standard errors in parentheses are clustered by municipality.

2.4.3 Specification With Multi-Dimensional Score

This section will explore our results with a multi-dimensional score point it out by Keele e Titiunik (2015), Cattaneo *et al.* (2024), Lehner (2024b). Figure 4 displays the point estimates for each boundary point, b_b of the equation 2.9. Figure

4 displays two types of confidence interval: the conventional if 95% confidence interval for the optimal bandwidth and the robust confidence interval calculated with an MSE-optimal bandwidth at each point. The figure also plots the location of the estimation on a map.

It is important to highlight that the model automatically excluded some points due to insufficient nearby observations, which would have compromised the reliability of estimation and inference. Following the general guideline of maintaining at least 30 observations on each side of the RD cutoff (LEHNER, 2024a), we adopt a more conservative threshold of 40 observations in our model. Moreover, many of the confidence intervals for the point estimates include zero. This outcome is not particularly concerning, as the limited number of observations near certain boundary points reduces the statistical power to detect significant effects. These limitations emphasize the importance of cautious interpretation when dealing with sparse data in spatial RDD settings.

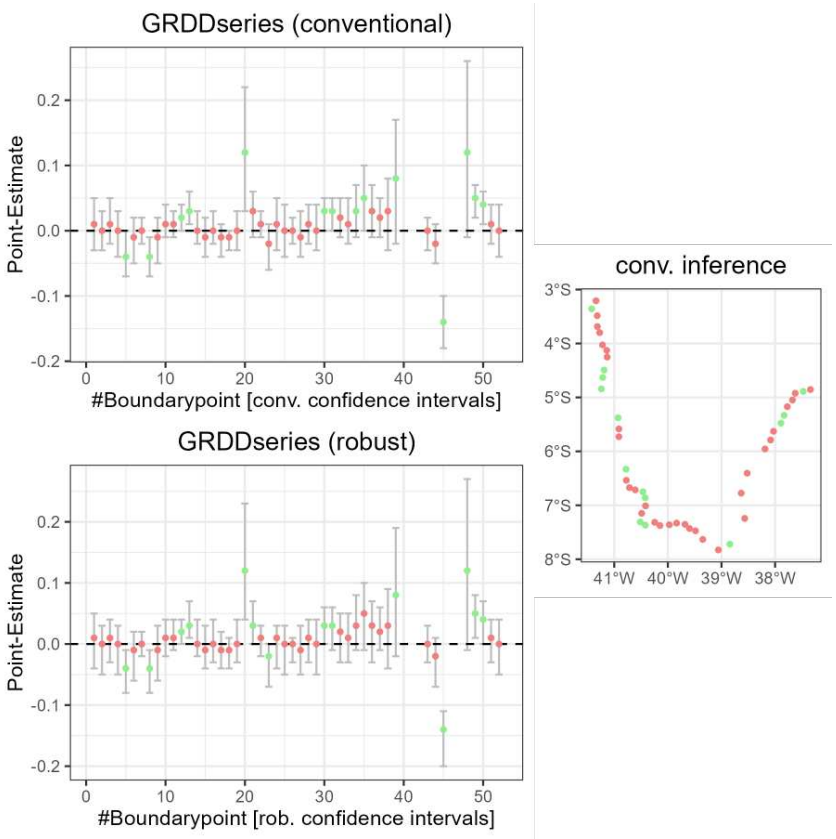
Our geographic analysis reveals that SQMI in schools between 2011 and 2017 along Ceará‘s borders shifted across the border, showing positive and negative magnitudes at different points. These results lead us to believe there was some heterogeneity in implementing the TA police and RBF mechanism across different regions of Ceará. The results for each year are present in Figure A2.2 and tables A3.9, A3.10 A3.11, A3.12, A3.13, A3.14, A3.15, A3.16 presents the results in each point of the geographic estimation.

The overall boundary-wide effect estimated using equation (2.9) is 0.011, which aligns with the estimate of 0.012 present in Panel A of the table (1) that uses linear specification. The result is also closely related to the one-dimensional score in Panel B of Table (2) with 10 segments using parametric specification with optimal bandwidth defined by Calonico *et al.* (2014) model.

It is essential to highlight that insignificant point estimates in these

areas do not necessarily mean that there is no effect on the cutoff. Instead, they suggest that the effect size might be too small to be detected, given the limited sample size used in the analysis. In other words, the lack of statistical significance reflects an issue of statistical power—the ability of the test to detect an effect when it exists. A small sample size reduces the precision of the estimates, making it more difficult to identify subtle or modest effects, even if they are present.

Figure 4 – Spatial RDD 2011-2017



Note: Figure 4 points the spatial RDD results in 2011-2017 to SQMI in borders schools. The green points are the significant ones, and the red are the points that are not significant.

2.4.4 Robustness Results - Difference-in-Difference

As a robustness check on the results we find in table 1, we estimate a different model to obtain the effect of school management practice on Ceará versus adjacent states: Piauí, Rio Grande do Norte, Paraíba, and Pernambuco[14] using our empirical strategy employed a Difference-in-Difference [15] model similar to Lautharte *et al.* (2021), Carneiro e Irffi (2023) to identify the causal effect of school management practice on Ceará's schools after the educational reform as a quasi-natural experiment. In the first difference, we compare school management outcomes for municipal schools in Ceará, exposed to the educational reform as a treatment group, and schools in the adjacent states that were not exposed to the reform as a control group. The second difference is the year the educational reform was implemented, i.e., after 2007, we consider treatment years. The econometric specification is defined by:

$$Y_{imst} = \beta_1 d_{09t} + \beta_2 S_{ims} + \beta_3 d_{09t} * S_{ims} + X'_{ist}\beta_8 + \tau_m + \tau_t + \varepsilon_{ismt} \tag{2.10}$$

Where Y_{imst} denotes the school management practice index for the school i, in municipality m, state s in year t, d_{09t} is a dummy that represents the reform in Ceará; it equals zero before 2009 and one after that. S_{ims} is a dummy equal to 1 if the school is in Ceará and 0 if the schools are in Piauí, Rio Grande do Norte, Paraíba, and Pernambuco. Our coefficient of interest is β_3, representing the average

[14] In Pernambuco, until 2011, tax value added and conservation units also had weight. Still for Pernambuco, from 2011 on-wards 2% of the *Quota-Parte* was shared with municipalities based on education quality, and only recently, in Legislation 16.616/2019, the quota increased to 18% until 2025, as is the case in Ceará. Although Pernambuco has adopted the same RBF mechanism as Ceará, it will only implement it in 2025. Excluding Pernambuco from our estimates results does not change the interpretation in any meaningful way.

[15] Good examples of the use of this methodology in Ceará educational reform context are: Shirasu *et al.* (2013a), Petterini e Irffi (2013), Brandão (2014a), Carneiro e Irffi (2018), Silva (2021), Irffi *et al.* (2021), Carneiro *et al.* (2022).

within-school change in our outcome variables in schools in Ceará after educational reform. τ_m and τ_t represent municipal and time fixed effects. Standard errors are clustered by the municipality.

The threat of identification stems from the possibility that schools differ after the educational reform. Two strategies have been adopted to overcome this problem. First, we consider a large set of predetermined school-level controls, represented by the vector X'_{ist}. This allows for the absorption of observable differences among the schools measured before the introduction of the educational reform. Second, we use the balanced entropy method, developed by Hainmueller (2012), to pair the schools through the predetermined variables. The pairing method allows for comparing homogeneous schools.

Building on the methodology proposed by Delgado e Florax (2015), we conduct an estimation that extends the traditional DiD approach by explicitly accounting for spatial dependencies. This spatial DiD framework allows us to incorporate potential spillover effects, where the treatment applied to one region may influence neighboring areas, a dynamic often overlooked in conventional analyses. By including a spatial weight matrix, which defines the relationships between units, this method captures both the treatment's direct and indirect effects that propagate across regions. The following equation defines the estimation:

$$Y_{imst} = \alpha + \beta_1 d_{09t} + \beta_2 S_{ims} + \beta_3 d_{09t} * S_{ims} + \rho W Y_t + \theta W X'_t + X'_{it}\gamma + + \tau_m + \tau_t + \varepsilon_{ismt} \tag{2.11}$$

Where S_{ims} is our spatial dummy that define if the school in Ceará o zero otherwise. WY_t is the spatial lag of the dependent variable, capturing spillover effects. ρ is the coefficient for the spatial lag of the dependent variable, θ is the coefficient for the spatial lag of covariates. X'_{ist} is our control variables. Our

coefficient of interest is β_3, which represents the average within-school change in our outcome variables in schools in Ceará after educational reform.

Panel A of Table 4 presents the results from equation (2.10). Each column sequentially incorporates a set of control variables to assess the robustness of the estimated effects. All covariates are predetermined and measured in 2007, prior to the implementation of the educational reform. In column (5), we include all predetermined variables and apply entropy balancing, as proposed by Hainmueller (2012). This matching procedure enhances comparability between treated and control schools by assigning weights that increase their similarity.

In column (6), we re-estimate the equation (2.10) but restrict the sample to the optimal bandwidth of 32.23 km, as defined in the RDD model. Column (7) reports results from estimating equation (2.11), which implements a spatial difference-in-differences approach to account for geographic variation in treatment exposure.

Panel B, following the approach of Costa e Carnoy (2015), Lautharte *et al.* (2021), examines the robustness of the results by using alternative definitions of border areas. Specifically, we re-estimate equation (2.10) while excluding schools located directly at each border, providing a complementary specification that tests the sensitivity of our findings to boundary definitions.

The overall improvement in school management practice outcomes is similar in Panel A for columns (1) to (4); these results suggest that the results are robust when we add control variables. The result in column (5), when we use weighted variables, is a little bigger than the other results and similar to the cubic specification in Table 1, and with the parametric specification with optimal bandwidth in Table 2. All the results are significant at 5%.

Panel B provides a baseline view of how excluding different states impacts the school management index in Ceará. Even with a state's exclusion, the

results are consistent and vary from 0.008 SDs to 0.011 SDs, indicating that schools in Ceará had better management practices outcomes after the educational reform.

This pattern of results, similar to the main results in Table 1 across different state exclusions, underscores the robustness of the main findings and supports the conclusion that educational reform in ceará was essential to improve effective management practices in schools.

Table 4 – Regression results for municipalities on the border and removal of states from the border

PANEL A: All municipalities in the border							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Treatment	0.007**	0.007**	0.007**	0.007**	0.009***	0.008**	0.003**
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.004)	(0.001)
Num.Obs.	11107	11107	11107	11107	11107	4043	11107
R2 Adj.	0.247	0.25	0.249	0.25	0.261	0.254	0.261
Covs	No	Students	Schools	Teachers	Entropy Balancing	Entropy Balancing	Entropy Balancing
Spatial Lag	N	N	N	N	N	Y	Y
Optimal Bandwith (32.23 km)	N	N	N	N	N	Y	N
Cluster	Municipality	Municipality	Municipality	Municipality	Municipality	Municipality	Municipality
F.E	Year + Municipality	Year + Municipality	Year + Municipality	Year + Municipality	Year + Municipality	Year + Municipality	Year + Municipality
PANEL B: Removing 1 state from border							
	Except PI		Except RN		Except PB		Except PE
Treatment	0.011***		0.008**		0.009**		0.008**
	(0.004)		(0.003)		(0.004)		(0.004)
Num.Obs.	9470		10161		10671		10076
R2 Adj.	0.267		0.254		0.26		0.263
Covs	Entropy Balancing		Entropy Balancing		Entropy Balancing		Entropy Balancing
Cluster	Municipality		Municipality		Municipio		Municipality
F.E	Year + Municipality		Year + Municipality		Year + Municipality		Year + Municipality
Cluster	Municipality		Municipality		Municipio		Municipality
F.E	Year + Municipality		Year + Municipality		Year + Municipality		Year + Municipality

Note: *** denotes significance at 1 percent, ** at 5 percent, and * at 10 percent level. the table 4 presents the results using DiD model on educational management practice in Ceará and border states. The student's controls are the percentage of white students, percentage of race not declared students, percentage of female students, and mean student age. The school's controls are student per class, special needs facilities, computer lab, science lab, special education classroom, sports court, library, and internet access. The teacher's controls are female teacher percentage, white teacher percentage, race not declared teacher percentage, postgraduate teacher percentage, and classes per teacher. By choice, the authors decided to omit the covariate results. Municipality-specific and time trends fixed-effects are included. Standard errors are clustered by municipality.

2.4.5 Placebo Test

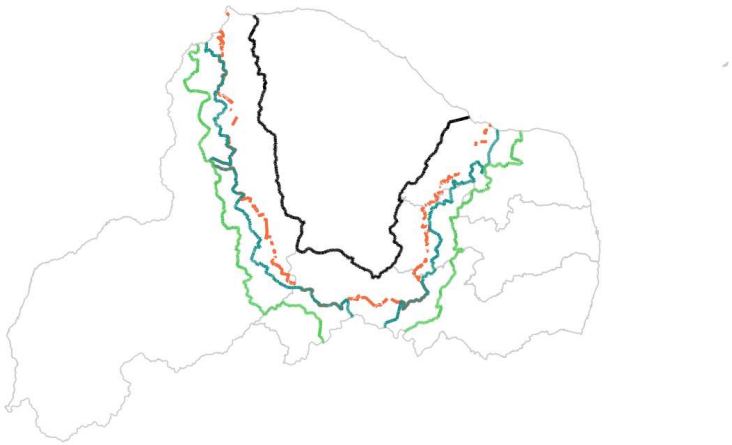
To validate our results, we conducted a placebo test. We re-estimated the equation (2.6), but instead of using the original Ceará border, we shifted the borders to varying distances from the original location.

We shift the original border to different distances for two main reasons. First, we aim to validate the robustness of our results from the original setup by ensuring that the outcomes are not sensitive to slight variations in the border's

location. If the results remain consistent, the credibility of our findings will be strengthened. Second, we seek to investigate whether there are any spillover effects on neighboring states. Specifically, we want to verify that these schools do not copy any school management practice of Ceará. This could indicate that the reform's impact is geographically contained and specific to the policy's intended targets.

Figure **??** illustrates the alternative border distance configurations used in the robustness check. To evaluate the robustness of our results and examine potential spillover effects, we shift the original Ceará border outward by 40, 60, and 100 kilometers. These placebo borders allow us to re-estimate the model in regions not directly exposed to the policy intervention. By testing for effects near these artificial borders, we assess whether the observed impacts are truly attributable to the Ceará-specific policy or if cross-border dynamics may confound them. This strategy strengthens the validity of our findings by confirming that the effects are localized and not driven by external or neighboring influences.

Figure 5 – Placebo Borders - Shifts of borders



Note: Figure 5 illustrates the different borders used in the placebo test. The black line represents the original Ceará border. In contrast, the orange, dark green, and green lines correspond to shifted borders at distances of 40 km, 60 km, and 100 km from the original border, respectively.

Table 5 reports no significant effects across the shifted border configurations for the main estimation period (2011 to 2017). These findings reinforce the conclusion that the positive impact of Ceará's educational reform on school management is localized and does not extend to schools in neighboring states. The results show that school management practices in municipalities near the placebo borders remained unaffected, with consistent null effects across linear, quadratic, and cubic specifications.

Across all model specifications, the McCrary test confirms the validity

of the RDD design by detecting no evidence of manipulation in the running variable at the cutoff. This further supports the credibility of the identification strategy and strengthens the interpretation that the observed effects are driven by the reform implemented specifically in Ceará.

The findings suggest that municipal schools in neighboring states did not experience any spillover effects. This outcome can be explained by the program's structure, where financial transfers are tied to the performance of municipal schools, and technical assistance is exclusively directed toward schools within Ceará.

These results can also be interpreted as evidence of limited spillover effects. By examining areas near the shifted borders, we effectively assess whether neighboring municipalities in other states adopt practices similar to those implemented in Ceará. The lack of significant changes across all specifications suggests that the reform's effects were geographically contained and did not spread beyond Ceará's boundaries. This highlights the program's specificity and the challenges of informal policy diffusion across borders, even when adjacent regions might have incentives to replicate successful initiatives.

Table 5 – Placebo Borders Results RDD estimation - Results for Linear, Quadratic, and Cubic Specifications across different years

	40 km	60 km	100 km
Panel A: Linear Specification			
Rd Estimator	0.015	-0.003	-0.018
Robust p-value	0.113	0.738	0.031**
Robust conf. Int.	[-0.004 , 0.034]	[-0.021 , 0.015]	[-0.034 , -0.002]
CCT-Optimal BW	19.512	22.504	22.668
Eff. Number Obs	1400	1610	1640
Mccray test (robust p.value)	0.131	0.528	0.233
Panel B: Quadratic Specification			
Rd Estimator	0.016	-0.005	-0.024
Robust p-value	0.185	0.64	0.005***
Robust conf. Int.	[-0.008 , 0.039]	[-0.026 , 0.016]	[-0.040 , -0.007]
CCT-Optimal BW	27.245	32.054	41.184
Eff. Number Obs	1840	2188	2870
Mccray test (robust p.value)	0.131	0.528	0.233
Panel C: Cubic Specification			
Rd Estimator	0.007	-0.004	-0.027
Robust p-value	0.527	0.708	0.002***
Robust conf. Int.	[-0.016 , 0.031]	[-0.026 , 0.018]	[-0.044 , -0.010]
CCT-Optimal BW	44.231	47.399	65.354
Eff. Number Obs	3031	3036	4633
Mccray test (robust p.value)	0.131	0.528	0.233

Note: *** denotes significance at 1 percent, ** at 5 percent, and * at 10 percent level. Table 5 reports source RD estimates of the effect on the School Management Quality Index (SQMI), considering the year of 2011 to 2017 in different border shift, the first one in column (1) reports a 40 kilometers distance to Ceará border, column (2) a 60 kilometers distance to Ceará border and column (3) a 100 kilometers to Ceará border. Panel A shows the linear specification, Panel B the quadratic specification, and Panel C the cubic specification. Optimal bandwidths following (CALONICO *et al.*, 2014). We include weighted control variables. We report robust-bias corrected p-values. The estimation used control variables. By choice, the authors decided to omit the results. Standard errors are clustered by municipality.

2.5 Mechanism

A possible explanation for the results obtained in the School Management Index may be related to the school's size and capacity to assimilate new pedagogical and administrative practices.

Smaller schools, with fewer students and a lower incidence of age-grade distortion (i.e., students within the appropriate age range for their grade), tend to

adopt new methodologies more easily. This is because, in general, these schools have a teaching staff that is more proportional to the number of students and faces fewer logistical and structural challenges. In contrast, larger schools, with more students and a higher incidence of age-grade distortions, may encounter greater difficulties in efficiently absorbing and implementing innovations due to a more complex environment and organizational challenges.

We use terciles to explore the mechanisms underlying the impact of the reform because this approach effectively captures heterogeneity in school performance and management practices. By dividing schools into terciles based on key indicators, we can identify distinct patterns of improvement or stagnation across different performance levels. This method allows us to examine the strategic responses of schools situated at various points in the distribution—whether low-performing schools are attempting to catch up, middle-performing schools are consolidating previous gains, or high-performing schools are working to maintain their advantage. Through this lens, we gain a more nuanced understanding of how schools engage with the reform depending on their initial conditions.

Moreover, this categorization helps highlight differences in school composition, such as socioeconomic backgrounds, teacher qualifications, and infrastructure. Schools in lower terciles may face more significant structural challenges, while those in higher terciles often benefit from better resources and community support. Thus, analyzing terciles provides a nuanced understanding of how the reform's mechanisms operate across diverse school contexts, offering valuable insights into targeted policy interventions.

In this context, we investigate possible mechanisms that may influence different groups of schools. To do so, we selected the institutions included in the sample up to 2009 and grouped them into three categories based on the distribution's

terciles[16]. Additionally, we identified and selected seven key variables that could impact the adoption and implementation of school management practices.

These variables were chosen for their relevance in the educational and organizational context, considering factors such as student profiles, teaching staff, and the structural characteristics of the schools. Table 6 presents a descriptive analysis of the selected variables, providing an overview of the differences among the analyzed groups and offering deeper insight into the conditions that facilitate or hinder the implementation of management practices in each school context.

Table 6 – Descriptive Statistics by Tercile using sample of schools in 2007 and 2009

Tercile	**1º tertile**			**2º tertile**			**3º tertile**		
	Min	**Mean**	**Max**	**Min**	**Mean**	**Max**	**Min**	**Mean**	**Max**
School enrollment	1.0	162.7	238	239	331.4	450	451	763.9	3297
Teachers	1.0	8.6	12	13	16.1	20	21	32.1	128
Teachers with Postgraduate Education	0.0	0.0	0.05	0.1	0.1	0.2	0.2	0.4	1
Classes per Teacher	1.0	1.1	1.6	1.6	2.4	3.1	3.1	4.4	15
Age - grade distortion (1 to 9 grade)	0.4	19.0	26.5	26.6	32.4	38.4	38.5	48.9	100
Age - grade distortion (1 to 5 grade)	0.4	15.7	22.7	22.8	27.9	33.3	33.4	43.7	100
Age - grade distortion (6 to 9 grade)	0.5	25.6	34.3	34.4	40.8	47.4	47.5	58.8	100

For each of the selected variables and their respective terciles, we re-estimated equation (2.6), SQMI continues as the dependent variable. Each re-estimation was conducted by restricting the sample exclusively to the terciles of each variable, allowing us to assess the heterogeneous effects of these variables across different school groups.

We focused only on the period from 2011 to 2017, considering the subset of schools already present in the sample up to 2009. This approach ensures consistency in the analysis by tracking the impact over time for a comparable group of schools. The model was estimated linearly, maintaining essential control variables to minimize bias. Additionally, we used cluster-robust standard errors at

[16] The use of schools until 2009 it is to preserve of data sample and compare schools that appears in all of this years

the municipal level.

Table 7 provides a detailed analysis of the impact of school management practices on the School Management Quality Index between 2011 and 2017, considering three terciles based on variables such as the number of students, teachers, teachers with postgraduate education, classes per teacher and age-grade distortion. The comparison between the first tercile (smaller or less complex schools) and the third tercile (more prominent and more challenging schools) offers valuable insights into how these interventions affect schools in different contexts. The McCrary test was not violated, ensuring no manipulation at the cutoff point and reinforcing the robustness of the econometric model used. The results for each year are displayed in the Appendix in Tables A3.17, A3.18, A3.19, A3.20

In the first tercile (Panel A), the coefficients are low and statistically insignificant, such as the impact of teachers with postgraduate education. These results suggest that smaller schools with fewer organizational challenges experienced little to no significant improvement in their management practices. The simplicity of these schools' administrative structures may explain their limited response to the interventions, as they face fewer operational difficulties that require substantial management changes.

In contrast, the third tercile (Panel C) presents more substantial and statistically significant results. A teacher increase is associated with a 0.029 standard deviation improvement in the SQMI. At the same time, reducing age-grade distortion leads to a positive impact of 0.044 standard deviations. These findings suggest that larger and more complex schools—typically those in the third tercile—derived greater benefits from the interventions. These schools faced more pronounced organizational challenges, creating opportunities to adopt and institutionalize more effective management practices. As a result, they exhibited a higher potential for improvement compared to less complex schools. Notably, the

estimated effects in the third tercile exceed those observed in the main estimation reported in column (1) of Table 1, underscoring the importance of considering school heterogeneity when evaluating the reform's impact.

Table 7 – RDD estimation - Mechanism Results for Linear specification with outcomes between 2011/1017

	School enrollment	Teachers	Teachers with Postgraduate Education	Classes per Teacher	Age - grade distortion - 1 to 9 grade	Age - grade distortion - 1 to 5 grade	Age - grade distortion - 6 to 9 grade
Panel A: 1^0 tertile							
Rd Estimator	0.031	0.015	0.006	0.028	0.011	0.006	0.006
Robust p-value	0.127	0.365	0.631	0.101	0.419	0.655	0.743
Robust conf. Int.	[-0.009 , 0.07]	[-0.018 , 0.048]	[-0.018 , 0.03]	[-0.006 , 0.063]	[-0.015 , 0.036]	[-0.022 , 0.034]	[-0.029 , 0.041]
CCT-Optimal BW	32.122	34.149	45.137	34.280	21.595	22.396	25.396
Eff. Number Obs	677	854	919	539	405	424	503
Mccray test (robust p.value)	0.2046	0.1679	0.5886	0.3449	0.1074	0.1482	0.67
Panel B: 2^0 tertile							
Rd Estimator	0.014	0.016	0.024	0.017	-0.002	0.019	0.023
Robust p-value	0.256	0.235	0.066*	0.215	0.908	0.311	0.124
Robust conf. Int.	[-0.01 , 0.037]	[-0.011 , 0.043]	[-0.002 , 0.049]	[-0.01 , 0.044]	[-0.034 , 0.031]	[-0.018 , 0.056]	[-0.006 , 0.052]
CCT-Optimal BW	31.652	31.372	37.038	34.650	31.607	31.407	28.592
Eff. Number Obs	907	802	997	979	859	697	545
Mccray test (robust p.value)	0.3234	0.1735	0.1863	0.3386	0.2234	0.4992	0.1204
Panel C: 3^0 tertile							
Rd Estimator	0.024	0.029	0.026	0.017	0.044	0.044	0.039
Robust p-value	0.158	0.013**	0.088*	0.161	0.004***	0.004***	0.059*
Robust conf. Int.	[-0.009 , 0.056]	[0.006 , 0.052]	[-0.004 , 0.057]	[-0.007 , 0.042]	[0.014 , 0.075]	[0.014 , 0.074]	[-0.001 , 0.079]
CCT-Optimal BW	27.783	32.584	28.746	30.234	28.916	30.144	35.592
Eff. Number Obs	453	609	573	734	495	572	378
Mccray test (robust p.value)	0.6056	0.9152	0.5101	0.1526	0.2067	0.1499	0.3668

Note: *** denotes significance at 1 percent, ** at 5 percent, and * at 10 percent level. Table 7 reports source RD estimates of the effect of schools in Ceará on the School Management Quality Index (SQMI), considering 2011 to 2017. Panel A shows the linear specification, Panel B the quadratic specification, and Panel C the cubic specification. Optimal bandwidths following (CALONICO *et al.*, 2014). We include weighted control variables. We report robust-bias corrected p-values. The estimation used control variables. By choice, the authors decided to omit the results. Standard errors are clustered by municipality.

The results also indicate that schools with higher management complexity—particularly those in the third tercile—overcame organizational obstacles and improved their practices more than schools in border municipalities, which lacked access to the same policy interventions. These more complex schools demonstrated a greater capacity to adopt and implement effective management strategies, positioning them more favorably regarding institutional development. This evidence underscores the importance of targeting educational interventions toward environments facing greater structural and managerial challenges, where the potential for impact is especially significant.

While smaller schools may not require deep interventions, those with greater administrative complexity benefit significantly from improvements in the management practice index. These results reinforce the effectiveness of the inter-

ventions in more challenging environments, demonstrating that policies focused on school management can produce significant and sustainable outcomes.

2.6 Concluding Remarks

This chapter analyzed the impact of the educational reform implemented in Ceará, Brazil, after 2007 on school management practices. Using a School Management Quality Index (SQMI) as the primary outcome variable and Regression Discontinuity Design (RDD) methodologies, we find that schools in Ceará experienced a 0.012 standard deviation improvement in SQMI compared to schools in neighboring frontier states. The estimated gains proved robust across multiple specifications and robustness checks. When we used state schools that did not receive the TA program or RBF incentives as a comparison group and applied placebo tests using alternative border shifts, the effects disappeared—reinforcing the conclusion that the observed improvements are attributable to the reform. These findings suggest that the introduction of structured management practices played a key role in strengthening school governance in Ceará following the reform.

The results highlight the role of well-implemented management practices as a lever for enhancing school outcomes, particularly in regions where socioeconomic constraints restrict access to quality education. Ceará educational outcome were largely explored in literature (BRANDÃO, 2014a; IRFFI; CARNEIRO, 2018; LOUREIRO *et al.*, 2020; LAUTHARTE *et al.*, 2021; PETTERINI; IRFFI, 2013; SILVA, 2021), but the question that used to remains that those transformations were able to improve management practice were never responded until now. Using a RDD and a geographic RDD approach similar to Keele e Titiunik (2015), Lehner (2024b) to capture the difference across different points of the Ceará‘s border, we are able to answer this question.

The findings underscore the potential of targeted management practices

to improve educational quality, suggesting that policies supporting technical assistance programs are particularly effective in contexts similar to Ceará. By enhancing the capacity of school principals to adopt effective management practices, such policies appear to align local educational goals with broader policy objectives, particularly in regions facing educational underperformance. The positive association between management practices and student outcomes supports the premise that well-structured management systems are crucial for developing school environments conducive to learning.

Although the effect sizes we report are smaller than those found in related studies—such as (LEAVER *et al.*, 2019; LEAVER *et al.*, 2022; BRUNS *et al.*, 2018; HOOGERBRUGGE, 2019; BORGES *et al.*, 2024; BARBOSA, 2023)—which document impacts ranging from 0.02 to 0.07 standard deviations using various empirical strategies, our findings remain meaningful within the specific context of this study. We evaluate a statewide public policy, which inherently involves greater implementation challenges and institutional complexity than targeted pilot programs or localized interventions. Moreover, our analysis encompasses all elementary schools in Ceará. If we had restricted the sample to early grades—where the TA program was more intensively implemented and closely monitored—the estimated effects would likely have been larger. Therefore, while modest in magnitude, the results offer important evidence of the positive role structured, large-scale reforms can play in enhancing school management practices under real-world conditions.

The RDD analysis sheds light on the reform's impact, but it is crucial to acknowledge its limitations, particularly in focusing on late-stage effects. The framework primarily captures the reform's influence from 2007 to 2017, reflecting outcomes after the policy had been in place for some time. This LATE-stage analysis may overlook critical early responses to the reform or gradual adaptations that unfolded during the initial implementation phase. Consequently, while the

findings provide robust evidence of the reform's effectiveness, they may not fully represent the timing and progression of its impacts. This limitation highlights the need for caution when interpreting the results, as they offer a retrospective view rather than a comprehensive understanding of the reform's dynamic effects over time.

Although our identification strategy and robustness checks strongly suggest that good management practice increases the effect of educational reforms, we need to be careful in extrapolating these gains in different contexts (GLEWWE; MURALIDHARAN, 2016). The reforms implemented by Ceará, as well as the political and technical context, were essential in enabling this educational transformation (LOUREIRO *et al.*, 2020).

Focusing on the Ceará context may limit the generalizability of findings to other regions with distinct socioeconomic and educational dynamics. Future research could investigate the impact of each management practice individually and examine how contextual factors, such as management autonomy and institutional characteristics, affect the implementation and effectiveness of these practices.

Another promising avenue for future studies is evaluating the long-term sustainability of school management policies and understanding their interaction with other factors, such as teacher engagement and community support. These elements could provide a more comprehensive understanding of the pathways through which school management practices contribute to educational quality and equity.

3 SCHOOL MANAGEMENT QUALITY AND STUDENT ACHIEVEMENT

3.1 Introduction

The concern over school quality and improvement of student outcomes in scenarios of socioeconomic adversity has led to various studies with different approaches (POTTER *et al.*, 2002; REYNOLDS *et al.*, 2014). In this context, interventions and financial incentives have gained relevance over the years by promoting effectiveness and efficiency in the education area, one of the most costly areas for governments (DUFLO *et al.*, 2012; MURALIDHARAN; SUNDARARAMAN, 2011). On one hand, this can lead to improved educational outcomes, as pointed out by Glewwe e Muralidharan (2016); on the other hand, it may generate inequalities within the school environment, exacerbate discrimination among groups, and promote behaviors aimed at circumventing the established mechanism (NEAL; SCHANZENBACH, 2010; FIGLIO; GETZLER, 2006; JACOB; LEVITT, 2003; REBACK, 2008).

The result-based finance (henceforth, RBF) becomes particularly relevant in education, especially in developing countries, due to its potentially high cost-effectiveness when well-designed and implemented locally. Incentives can benefit the entire school community by improving learning indicators, enhancing management, and attracting more motivated and capable professionals (MURALIDHARAN; SUNDARARAMAN, 2011; LAZEAR, 2000; DUFLO *et al.*, 2012; SNILSTVEIT *et al.*, 2015; GLEWWE; MURALIDHARAN, 2016). Educational interventions have high payoffs in reducing significant achievement gaps at school (HECKMAN, 2008; BARNETT, 2002; CUNHA; HECKMAN, 2009). In particular, early tutoring programs such as: Reading First (USA), PAIC (Ceará-Brazil), PNAIC (Brazil), Reading Recovery (New Zeland), and EGRA (Africa) achieved improvements in

students' literacy results (GAMSE *et al.*, 2008; COSTA; CARNOY, 2015; CENTER *et al.*, 1995; RALAINGITA; WETTERBERG, 2011).

RBF mechanisms can generate even greater outcomes when aligned with targeted educational interventions. Ceará, Brazil, offers a unique example of such alignment, combining discretionary financial transfers to mayors with implementing a Technical Assistance (TA) program during the same period. This integrated approach contributed to Ceará's rapid ascent to a top-ranked position in national education assessments and indicators for primary education.

Ceará became the first state in Brazil to implement a tax transfer redistribution policy that links fund allocation to municipal educational performance. This policy and targeted technical assistance have significantly improved education outcomes (LOUREIRO *et al.*, 2020; CRUZ *et al.*, 2022). This model of education, combining RBF and TA, has been attempted by several other states. However, the results achieved were not comparable to those in Ceará. These results suggest that implementing an RBF and TA program alone may not yield the expected outcomes.

Although international tests like PISA and TIMSS are presented at national level and rank Brazil among the worst-performing countries, Sobral, one of the municipalities from the pilot program that later became TA, implemented the PISA for Schools in all its schools in 2018, and 2021. The 2021 results show that, on average, Sobral outperformed Brazil, France, Portugal, Italy, Chile, and Uruguay.

Several authors[1] point to the impact of changes with RBF policy, with results showing an increase of 0.08 SDs to 0.12 SDs in the *Prova Brasil/SAEB* test, depending on the author and methodology used. Among the initiatives developed under the Technical Assistance (TA) program, one of the most innovative

[1] See: Shirasu *et al.* (2013a), Petterini e Irffi (2013), Brandão (2014a), Carneiro e Irffi (2018), Silva (2021), Irffi *et al.* (2021), Carneiro *et al.* (2022)

was promoting partnerships between schools and disseminating effective school practices. This strategy culminated in the creation of the School of Excellence Award *(PEN10 - Prêmio Escola Nota Dez)*. Their results show that when Ceará provides technical assistance (teaching and management) to municipalities, these effects triple compared to RBF results alone and are particularly significant for 5th-grade students (CARNEIRO *et al.*, 2023).

Identifying the effect of sound management practices in schools before implementing RBF and TA policies in Ceará presents a methodological challenge, given the context-specific nature of educational outcomes and the complexities of measuring management quality across schools. This study addresses a central research question: Did the quality of school management play a pivotal role in shaping the impact of Ceará's educational reform by enhancing the outcomes of schools already practicing effective management?

Our findings suggest that, even before introducing new policies, schools with stronger management were better positioned to adopt and implement the changes brought by the reform. These schools demonstrated more substantial improvements in student performance, indicating that effective management amplified the benefits of the reform. In contrast, schools with weaker management struggled to fully capitalize on the policy innovations, resulting in more modest gains. Therefore, the quality of school management emerged as a key factor in mediating and magnifying the reform's impact on educational outcomes.

Our empirical strategy explores these reforms across schools in Ceará and other border states to identify the management effect on learning at the end of primary (5th grade) and lower secondary (9th grade) education. Using the school management quality index (SQMI) developed by Leaver *et al.* (2019) as a high enforcement variable and *Prova Brasil/SAEB* proficiency test as outcomes[2], and

[2] It is essential to highlight the use of *Prova Brasil/SAEB*. First, *Prova Brasil/SAEB* is not part of the RBF rule in Ceará. Instead, Ceará bases the redistribution criteria on its state assessment

also the retention and abandonment results for students as an outcome. We adopt a difference in difference in difference (DDD) approach to identify the effect of the new programs on Ceara schools [3].

To ensure the validity of our findings and address potential pre-existing differences between groups, we established a baseline by calculating the difference in outcomes during the pre-educational reform period (2007). The 2005 test data was excluded from this baseline analysis due to two key factors: Firstly, the testing procedure in public schools before 2005 involved a randomized selection of schools, resulting in a small and potentially unrepresentative sample. Secondly, insufficient contextual data was available in 2005 to reproduce the SQMI accurately. Given the limited pre-treatment period, we implemented various strategies to adjust and refine our model. One specific approach involved conducting a sensitivity analysis, as outlined by Rambachan e Roth (2023)

We found positive and significant impacts of the program. According to our estimates, in 5th grade, students in Ceará presented 0.1 SDs with high scores in mathematics and 0.09 SDs in language compared to similar students across border states who were not exposed to the educational reform. This difference has increased over the years and reached the highest score in 2015; on average, this result has been equivalent to an additional two (2) months of learning. However, in 9th grade, the results are only significant after 2015, when the TA was implemented for lower secondary education. In language, the results for Ceará schools increased by 0.1 SDs and mathematics by 0.08 SDs.

While previous findings highlighted significant improvements in language and mathematics proficiency for 5th and 9th-grade students, the retention and aban-

called SPAECE. *Prova Brasil/SAEB* is a national assessment without fiscal redistribution influence. In this context, using *Prova Brasil/SAEB* is empirically essential because it is less susceptible to gaming by municipalities

[3] The application of *Prova Brasil/SAEB* occurs in odd years since 1995, and in 2007, become mandatory for all public schools that have fifth and ninth grade

donment rates analysis reveals mixed outcomes. For primary education, substantial reductions in retention were observed after 2009 and in abandonment after 2013, varying from 1% to 4%, to demonstrate localized impacts of management reforms such as TA and RBF. However, in lower secondary education, no significant changes were found, reflecting systemic challenges such as socioeconomic disparities and accumulated learning gaps, particularly for disadvantaged students. These findings emphasize the limitations of the reforms in addressing deeper structural issues in secondary education and highlight the need for complementary interventions to reduce retention and abandonment while promoting equitable educational outcomes effectively (CURY, 2008; VIEIRA *et al.*, 2019).

The analysis highlights the significant economic and educational benefits of effective school management practices in Ceará, mainly through retention, abandonment, and performance incentives. By aggregating the results for student retention and abandonment, it is evident that schools with good management practices avoided substantial municipal costs. Specifically, between 2011 and 2017, municipalities saved approximately 25 million reais by avoiding costs associated with grade repetition and student abandonment, demonstrating the tangible value of targeted management reforms in fostering educational efficiency and fiscal sustainability.

In addition to these gains, schools above the SMQI median received 27 million reais more in financial bonuses from the PEN10 than those below the median. These economic impacts highlight the dual benefits of effective school management: improving student outcomes while reducing fiscal pressures on municipalities.

These findings underscore the dual benefits of reducing inefficiencies—such as grade repetition and abandonment—and incentivizing excellence through targeted bonuses. Together, they demonstrate how effective school management can drive economic savings and improved educational outcomes, providing a sustainable

framework for broader educational reforms.

Exploring the SQMI topics[4], we divided each subject as a potential channel for our findings. The results show the effectiveness of school management practices in educational outcomes. In 5th and 9th grades, topics such as management talent and standardization of instructional process emerged as critical drives of student success in mathematics and language. However, the analysis also reveals the complexities of implementing management practices effectively. The adverse outcomes associated with performance reviews suggest that managing this practice needs to be careful, or it can detract from student outcomes. This topic evidences the need for management practices that are strategically designed and sensitively implemented to encourage a positive and productive educational environment. Those findings reinforce the idea that while effective management is essential, its success depends heavily on the context and manner in which it is applied.

This chapter addresses a critical gap in the literature by examining how the SMQI shapes the outcomes of educational reforms in Ceará. While previous research, such as Lautharte *et al.* (2021), Loureiro *et al.* (2020), Irffi *et al.* (2021), Carneiro *et al.* (2022), has highlighted aggregate improvements in literacy and performance metrics, little attention has been given to the role of pre-existing management practices in driving the success of initiatives like TA and RBF.

By analyzing the interplay between SMQI and reform outcomes, this study uncovers how strong management practices enhance policy effectiveness, leading to more significant gains in student proficiency and reductions in municipal costs associated with retention and dropout. This approach sheds light on the variability of reform outcomes, offering practical insights for replicating Ceará's successes in other regions.

A key contribution of this research is its integration of management

[4] In Table B3.11 on appendix, we detailed the question in each topic.

quality into the analysis of TA and RBF. Schools with robust management systems were better positioned to achieve significant educational improvements, particularly in primary education, while also realizing fiscal benefits. By incorporating mechanisms like the PEN10 and quantifying associated economic savings, the study highlights the strategic importance of effective school management for sustainable reform outcomes.

These findings advance the literature on educational reforms in Brazil by offering a nuanced perspective on the systemic impact of management practices. This research enriches the discourse on education policy and underscores the broader role of management quality in enhancing public sector performance.

This chapter also contributes to two strands of the literature. First, it contributes to the literature of educational reform in Brazil, particularly in Ceará (SHIRASU *et al.*, 2013a; PETTERINI; IRFFI, 2013; BRANDÃO, 2014a; CARNEIRO; IRFFI, 2018; SILVA, 2021). It is mainly related to Lautharte *et al.* (2021), Veloso e Barbosa (2021), Silva (2021), which shows an improvement in students' test scores when exposed to RBF and TA. However, before implementing the educational reform, our study points out inequalities in educational outcomes, especially in schools with high performance and management practices.

Second, we contribute to recent literature that investigates the effects of improvement in the quality of school management (BRUNS *et al.*, 2018; HOYOS *et al.*, 2017; FRYER *et al.*, 2017; ROMERO *et al.*, 2020; LEMOS *et al.*, 2024; LEAVER *et al.*, 2019; MURALIDHARAN; SINGH, 2020). Some evidences in Brazil were also found (LEAVER *et al.*, 2022; BRUNS *et al.*, 2018; HOOGERBRUGGE, 2019; TAVARES, 2015; TEODOROVICZ *et al.*, 2023). Furthermore, a recent meta-analysis on school management programs found that improving school management quality affects learning Anand *et al.* (2023).

The chapter is organized as follows. After this introduction, section 2.2

provides background information on Ceará and explains the RBF and TA in the Ceará context. Section 2.3 describes the data and the empirical strategy. Section 2.4 presents the main results and robustness tests. Section 2.5 investigates several mechanisms explaining our results. Section 2.6 highlights the economic implications of schools with effective management practices. Section 2.7 concludes.

3.2 Institutional Background

Ceará, located in Brazil's Northeast, is part of one of the country's poorest regions. With a population of 8.7 million, it ranks as the eighth most populous state in Brazil, with three-fourths of its residents living in urban areas. In 2019, the state's monthly per capita income was US$ 233.80, significantly lower than the national average of US$ 356.93, making it the fourth-lowest GDP per capita in the country[5].

Despite these challenges, Ceará has achieved remarkable progress in education[6]. The state implemented a comprehensive educational reform focused on improving literacy among elementary school students. This progress was driven by a combination of Results-Based Financing (RBF) policies and Technical Assistance (TA), integral components of its broader education reform strategy (LOUREIRO *et al.*, 2020).

3.2.1 The Result-Based Financing Reform in Ceará

In 2007, Ceará approved the law to reformulate how municipalities received redistributed state consumption tax revenues. The *Imposto sobre Circulação*

[5] The data on Ceará's economic activity, demographics, and socioeconomic characteristics are from Instituto Brasileiro de Geografia e Estatística (2019), Cavalcante *et al.* (2019)

[6] The Economist featured an article on Ceará's education model and its global relevance, available at https://www.economist.com/the-americas/2021/12/18/what-a-brazilian-state-can-teach-the-world-about-education. Additionally, BBC News published a related article, accessible at https://www.bbc.com/portuguese/articles/cev9g2jrxp0o

de Mercadorias e Serviços (henceforth, ICMS) is the primary source of tax revenue for the sub-national government that taxes services and family consumption. Based on discretionary legislation, the ICMS structure requires municipalities to receive one quarter (25%) of ICMS revenues, known as *Quota-Parte* (HOLANDA *et al.*, 2007; HOLANDA *et al.*, 2008).

The *Quota-Parte* rules change in each state of Brazil; in some states, they use municipal population size, area, and equal distribution[7]. Ceará enacted Legislation 14.023 in December 2007[8], introducing a RBF model to redistribute *ICMS Quota-Parte* based on education (18%), health (5%) and environmental perfomance (2%)[9] (HOLANDA *et al.*, 2008). which means that municipalities with greater improvements in literacy rates, pass rates, and learning scores will receive a higher fraction of *ICMS Quota-Parte* than municipalities with lower overall performance. The RBF intends to generate incentives for local authorities to reduce learning disparities. For poorer municipalities, the ICMS rewards can be more than half of total municipal revenues.

This paper focuses on education outcomes of the preeminence in the *ICMS Quota-Parte* redistribution rule. The initial model shows that municipalities with more considerable improvements in literacy rates, pass rates, and learning

[7] Among the adjacent states of Ceará, Rio Grande do Norte has a *Quota-Parte* rule largely based on equitable distribution among municipalities, and a smaller fraction based on demographic and/or territorial variables. Other states, such as Piauí and Paraíba, use a similar rule but add a percentage for trash treated and an environment indicator (less than 10%). In Pernambuco, until 2011, tax value added and conservation units also had weight. Still for Pernambuco, from 2011 on-wards 2% of the *Quota-Parte* was shared with municipalities based on education quality, and only recently, in Legislation 16.616/2019, the quota increased to 18% until 2025, as is the case in Ceará. Although Pernambuco has adopted the same RBF mechanism as Ceará, it will only implement it in 2025. Excluding Pernambuco from our estimates, besides Carneiro *et al.* (2022) finding positive results, the inclusion of this state results does not change the interpretation in any meaningful way (see Table B3.4, B3.5, this new legislation is also not captured in our sample that is between 2007 and 2017. For more information, see: Simões e Araújo (2019)

[8] Besides, approved in 2007, the RBF redistribution only started in 2009. This information is important because we considered the *Prova Brasil/SAEB* in 2007 as a pre-treatment period.

[9] Figure B2.2 in Appendix 2 presents a scheme for the distribution

scores[10].

3.2.2 Technical Assistance - (Pacto pela Alfabetização na Idade Certa, PAIC)

In 2007, Ceará also established that "all municipal public school students should be literate by the end of second grade (age 7)". Based on this goal, the government approved the 14.026 legislation, which started a Literacy Program at the Right Age (*Pacto pela Alfabetização na Idade Certa, PAIC*), which is a non-mandatory technical assistance (TA) package available to all municipalities. This package includes actions from continuous teacher training and support for school management to providing structured materials, pedagogical diagnostics, and efforts to standardized tests (COSTA; CARNOY, 2015; SEGATTO; ABRUCIO, 2016; LAUTHARTE *et al.*, 2021)

To coordinate these actions, Ceará created a collaborative governance arrangement structure. Vieira e Vidal (2013) argue that Ceará has established itself as a territory of educational cooperation in three key areas: through collaboration between the state and municipal governments, with various instruments of direct support—such as *Quota-Parte*, SPAECE exam, and PAIC; through collaboration between the state government, municipalities, and schools, via regional education bodies; and through cooperation between the schools themselves.

Among the actions developed within the scope of TA, one of the most innovative was encouraging partnerships between schools and fostering the dissemination of good school practices. The program's creation materialized this strategy introduced the *PEN10* through legislation 14,371/2009 to support municipalities in improving their education networks. The program distributes financial bonuses to

[10] Besides the *Quota-Parte* redistribution is measured using the local exam (SPAECE), we use the national *Prova Brasil/SAEB* exam to reduce the influence of gaming in our findings

150 schools whose students achieve high Ceará basic education evaluation system tests (CARNEIRO; IRFFI, 2023).

In summary, the TA centered on management, focused on student learning, and emphasized changing the municipal and school management culture. The TA initially targeted literacy for second-grade students, and in 2011, the first recalibration happened, expanding the program to include and support grades 3 to 5; in 2015, the second recalibration expanded again to include grades 6 to 9. It is important to note that although policymakers recalibrated the RBF criteria in 2017 to include the G9 results, the corresponding financial transfers have yet to be implemented.

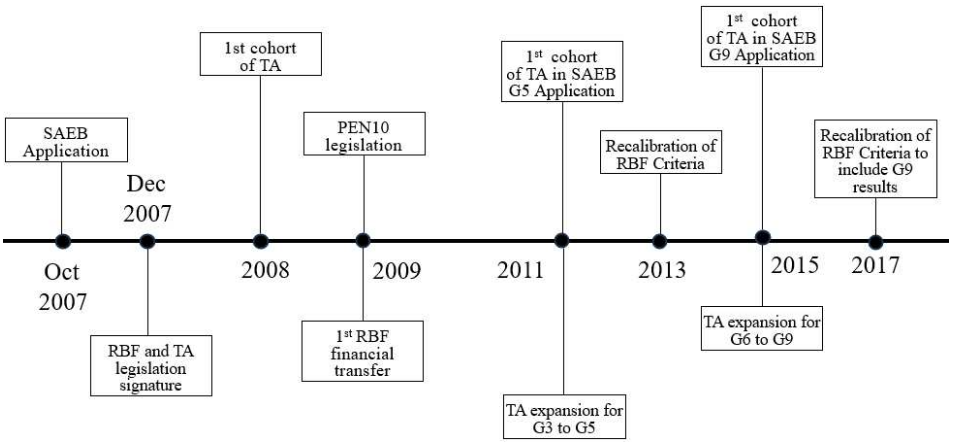
Implementing the TA and RBF reforms in Ceará was guided by a strategic policy framework that sought to align incentives with educational outcomes. At the core of this approach was the redistribution of ICMS tax revenue, which tied municipal funding directly to the performance of local schools. This innovative mechanism created strong financial incentives for municipalities to prioritize education, stimulating healthy competition and encouraging the adoption of effective management practices tailored to each region's specific challenges and needs. By linking fiscal resources to school performance, the policy promoted accountability and motivated local governments to invest in sustained improvements in educational quality.

These reforms were introduced as part of a broader strategy that progressively aligned municipal and state-level objectives to reinforce performance-driven outcomes. By creating a unified focus on improving student proficiency and reducing inefficiencies, such as retention and abandonment, the reforms established a clear pathway for sustainable educational advancements. To better illustrate the evolution of these initiatives, figure 6 detailing the key legislative milestones, such as the introduction of ICMS redistribution and the rollout of TA and RBF, would

highlight how these policies cumulatively shaped Ceará's educational landscape. This alignment of fiscal and educational goals created a robust framework that allowed municipalities to innovate while adhering to overarching state directives, ultimately driving the reforms' success.

Ceará's integration of financial and educational policies set a precedent for leveraging economic incentives to achieve sustained improvements in public education. Notably, even the announcement of certain policies, despite not being fully implemented, produced measurable results (MARINHO, 2022; CARNEIRO *et al.*, 2023).

Figure 6 – Timeline of Ceara Educational Reforms



Note: Figure 6 points to TA implementation milestones (2007–2017). It highlights the SAEB application, legislation for RBF and TA, the creation of the PEN10 award, financial incentives, and the expansion of TA support from grades 3–9. Recalibration of RBF criteria in 2013 and 2017 refined performance-based funding and included Grade 9.

The educational reform in Ceará, which introduced the RBF model alongside technical assistance, was made possible because municipalities hold administrative responsibility for primary and lower secondary education (LOUREIRO *et al.*, 2020). Under Brazil's federal structure, municipalities are empowered to formulate and implement policies across various sectors—including education—provided

they comply with overarching national and state regulations. This decentralized framework gives municipal secretariats of education full authority over school management. Their responsibilities include hiring and dismissing staff, providing professional development, and overseeing infrastructure maintenance. Since the 1988 Federal Constitution, Brazilian municipalities have borne primary responsibility for early childhood and elementary education. However, despite this constitutional provision, many regions in the country have not fully embraced this decentralized model.

In Ceará, most elementary schools are managed by the municipal system, which makes it easier to implement and expand decentralized management educational policies. The decision to decentralize the management of primary and early secondary education to municipalities clarified the roles and responsibilities of each level of government. It is worth noting that Ceará has two military elementary schools, which fall under state responsibility (BENEVIDES; SOARES, 2020).

Measuring results is critical to establishing an RBF system and identifying the municipalities that need more support. Setting a solid and reliable monitoring and evaluation system that continuously measures education outcomes was a key element established by the State Government in partnership with municipalities for all public schools. The results diagnose student levels and help set goals, which teachers and schools receive with training and monitoring actions. Combining these four ingredients creates a culture in which feedback is essential to improve performance throughout the system and enables action on a commitment to education quality.

Empirical evidence indicates that policies like the RBF and TA programs increase student performance (PETTERINI; IRFFI, 2013; IRFFI *et al.*, 2021; CARNEIRO *et al.*, 2022; LAUTHARTE *et al.*, 2021; BRANDÃO, 2014a; COSTA; CARNOY, 2015). Most of this literature analyzes the programs separately, even

though the RBF and TA programs are part of a broader set of initiatives within Ceará's educational reform. In our case, we study educational reform considering the RBF and TA programs, especially because Glewwe e Muralidharan (2016) shows that the combination of performance spending policies and incentives for their proper implementation can explain most of the results.

3.3 Data and Identification Strategy

3.3.1 Data

This study seeks to evaluate the impact of the Ceará educational reform program and focuses on schools with better SQMI in 2007, pre-reform. In this way, we use several sources of data information. Our main source of information is the National Basic Education Assessment System (*Sistema de Avaliação da Educação Básica, SAEB*) provided by the Anísio Teixeira National Institute for Educational Studies and Research (*Instituto Nacional de Estudos e Pesquisas Educacionais Anísio Teixeira*, INEP) between 2007 and 2017. *Prova Brasil/SAEB* is a national learning quality assessment applied to public schools in odd years.

The *Prova Brasil/SAEB* assessment is conducted at the end of each educational cycle—5th, 9th, and 12th grades—during alternate years. Because virtually only primary and lower secondary education are managed by municipalities in Ceará and are, therefore, part of the reform mechanism, our data is restricted to 5th and 9th grades[11]. *Prova Brasil/SAEB* began in 1995 as a sample-based assessment for public schools (municipal and state) designed to measure educational performance at the state level. In 2007, the test underwent significant changes, becoming mandatory for all public school students and sample-based for private

[11] Unfortunately, the public data provided by INEP for the *Prova Brasil/SAEB* exam does not align with the student ID in the school census and does not maintain the same code for a student across different editions of the Prova Brasil. This makes tracking a student's performance impossible over the years for public data.

school students. Additionally, it introduced questionnaires for students, teachers, and school principals.

To reduce the influence of gaming in our findings, note that *Prova Brasil/SAEB* is not part of Ceara results reform. Instead, the educational reform uses an independent state-level SPAECE. An additional advantage of using *Prova Brasil/SAEB* is that it provides unique city identifiers that allow us to explore the geographic properties of schools in our identification strategy and control for city and year-fixed effects.

The exam provides standard test scores in mathematics and language and collects detailed information about students, teachers, and school principals. We use those questionnaires to compute the SMQI. A detailed list of questions used to construct the index is in the appendix in Table B3.11.

There are two advantages to using the *Prova Brasil/SAEB* questionnaire for teachers and principals. First, there is the possibility of confronting two different perspectives on school management: the perception of teachers and principals. Second, the responses from teachers and principals are anonymous and low-risk. This advantage gives confidence that the answers reflect the perception of these school agents about the quality of school management.

We used the Brazilian National Educational Census collected by INEP to get information about school inputs (such as class size, teachers per class, teachers sex, race and education, number of enrollments, and school infrastructure) and student characteristics (sex, race, age). In this database, schools are uniquely identified by an 8-digit code, while students are identified with a 12-digit code.

These codes are generally called INEP codes. These characteristics, obtained for the year 2007, are used to calculate the weights that adjust the characteristics of the schools with SMQI above or below median through the entropy balancing method as described by Hainmueller (2012), to compare schools'

characteristics with the most similar attributes before treatment. We use entropy balancing to ensure precise covariate balance by reweighting data to match treatment and control groups on key covariate moments. This balance reduces model dependence, eliminates the need for repeated balance checks, and provides a more consistent basis for estimating treatment effects.

We also used the National Treasury Secretariat (*S*ecretaria do Tesouro Nacional, STN - SINCOFI) to calculate the average cost per student and how much additional funding a well-managed school receives; this dataset permits us to determine the total spending on education within municipal networks in Ceará. This allowed us to estimate the average cost per student in municipal education. Additionally, we utilized internal data of the State Department of Education of Ceará (*S*ecretaria de Educação do Estado do Ceará, SEDUC) on awards from the PEN10 program, broken down by school to measure the additional funds received by good managed schools compared to bad managed schools in our dataset.

Our data sample is pooled in a cross-section format for every two years between 2007 and 2017. For the 5th grade of primary education, 489,084 students were enrolled in proficiency tests in 1,368 schools. For 9th grade, are 353,418 students enrolled in proficiency tests across 1,268 schools. We fixed our sample only to schools that appear in all years of the estimation in Ceará and adjacent states: Piauí, Rio Grande do Norte, Paraíba, and Pernambuco[12].

Although Bahia is not an adjacent state to Ceará, it followed a similar system for redistributing 25% of tax revenue to municipalities until 2023. This system resembled Ceará's pre-2007 legislation, which allocated funds based on

[12] In Pernambuco, until 2011, tax value added and conservation units also had weight. Still for Pernambuco, from 2011 on-wards 2% of the *Quota-Parte* was shared with municipalities based on education quality, and only recently, in Legislation 16.616/2019, the quota increased to 18% until 2025, as is the case in Ceará. Although Pernambuco has adopted the same RBF mechanism as Ceará, it will only implement it in 2025. Bisides Carneiro e Irffi (2018) find positive results for this state in the old legislation, excluding Pernambuco from the results of our estimates does not change the interpretation in any meaningful way (see Table B3.4, B3.5)

specific criteria: 75% according to tax-added value, 12.5% proportional to education expenditures relative to municipal revenue, 7.5% distributed equally among municipalities, and 5% based on population size[13]. In Bahia, a portion of the funds was distributed proportionally based on population, while another portion was shared equally among municipalities. However, starting in 2024, 18% of the funds transferred to Bahia's municipalities will be tied to performance indicators, aligning with the system Ceará adopted in 2007. For this reason, we also include Bahia students in a robustness test, following the methodology of Petterini e Irffi (2013), Irffi *et al.* (2021).

3.3.1.1 Measuring school management practices

Evaluating the quality of public management presents significant challenges due to the multitude of factors that can influence managerial efficiency and the latent and unobservable nature of management quality itself. One established method for addressing this challenge is the assessment of specific management practices that have garnered broad consensus among consultants and field experts, indicating their causal relationship with organizational performance (HWA; LEAVER, 2021). This approach is exemplified by the World Management Survey (WMS), a prominent and widely utilized framework for assessing management quality across diverse settings developed by Bloom *et al.* (2015). In this context, adopting more of these identified practices is interpreted as indicative of superior management quality [14].

[13] Ceará's 1996 legislation established these criteria for distributing the ICMS share to municipalities.

[14] This approach has advantages and disadvantages. As an advantage, practices are easy to measure and observe. It is possible to estimate how these practices are implemented, which allows understanding beyond the simple presence (or not) of those practices. The disadvantage is that those practices do not necessarily imply management quality. For example, carrying out school performance assessments is considered a "good" practice in the school context. However, if the assessment's results are not used to develop actions to promote learning, then the presence or absence of evaluation may be innocuous

Although this approach is a reliable and consistent measure of management quality, it requires a costly procedure that is difficult to apply when there are many units to be analyzed, as is the case of the amount of public schools in Brazil. Some attempts to adopt procedures similar to the WMS have been made in Brazil (BORGES *et al.*, 2024; BARBOSA, 2023; HOOGERBRUGGE, 2019). However, these initiatives are restricted to a small number of schools in a given municipality.

The school management index developed by Leaver *et al.* (2019), Leaver *et al.* (2022) derived from *Prova Brasil/SAEB* data is constructed based on a harmonized mapping of Prova Brasil questionnaires spanning 2007 to 2017. The data includes responses from three *Prova Brasil/SAEB* questionnaires: school director, teacher, and student questionnaires. These are merged into a comprehensive student-level dataset, including 5th and 9th grade students. The dataset is then aggregated at the school-grade level for further analysis.

We follow Leaver *et al.* (2019), Leaver *et al.* (2022) to structured steps to construct the management index. First, we classify 29 questions from the combined *Prova Brasil/SAEB* dataset into seven categories aligned with the WMS topics. Second, we assign normalized scores ranging from 0 to 1 to these questions, in line with the WMS scoring methodology — that is, more structured practices are assigned higher scores — and build a set of indices from these individual question scores. Third, for each of the five topics, we calculate an average score using the questions classified into that topic, and these topic-specific scores are standardized based on their within-year distributions.

We compute the school-level management index for the main index and each topic using Anderson (2008) approach. These indexes are also standardized based on within-year question distributions. Our scores range between 0 and 1 and are measured in SDs. Anderson (2008) allows to assign weights to the included variables based on the sum of their row in the inverse variance-covariance matrix.

Doing so gives greater weight to questions that provide more "new information," effectively emphasizing variables with higher informational content and reducing the influence of those with redundant or less impactful contributions.

Besides the SQMI based on *Prova Brasil/SAEB* test does not include all topics of the original WMS survey, Leaver *et al.* (2019), Leaver *et al.* (2022) validated this measure by comparing it with the WMS index computed in 2013 for 273 Brazilian schools, the overall all results points out the indexes had a good correlation. We used this index in 2007 to measure the quality of school management before Ceará's educational reform. In Table B3.11 on appendix A3, we detailed the variables used by Leaver *et al.* (2019), Leaver *et al.* (2022).

3.3.2 Empirical strategy

Schools with good practices already in place before the implementation of reforms were able to achieve better educational results more quickly, leveraging their context of efficiency of their practices (ANGRIST *et al.*, 2020; RIDDELL, 1998; KIM, 2018). Intuitively, because these schools could have had better results over the years, we believe that Ceara's schools internalized the management process even before the change of educational reform.

To estimate the effect of above the median school management on students' 5th and 9th grades in 2007 for Ceará and adjacent states: Piauí, Rio Grande do Norte, Paraíba, and Pernambuco we develop a model using school-level pooled cross-section data with students scores from *Prova Brasil/SAEB*. Our empirical strategy employed a Difference-in-Difference-in-Difference (DDD)[15] model similar to Muralidharan e Prakash (2017) to identify the causal effect of educational

[15] Good examples of the use of this methodology are: Ravallion *et al.* (2005), Chaudhury e Parajuli (2010), Tyler *et al.* (2010), Chiapa *et al.* (2012), Costa e Carnoy (2015), Rosa *et al.* (2019).

results in *Prova Brasil/SAEB* using the management index in 2007 before the Ceará Educational reform as a quasi-natural experiment.

Angrist e Pischke (2009) point out that DDD model is a modification of a Difference-in-Difference (DiD) model with possible high-order control groups that contribute to the identification strategy with more than one dimension of external variation. The triple difference estimator requires a parallel trend assumption for the estimated effect to have a causal interpretation. Even though the triple difference is the difference between two difference-in-differences, it does not need two parallel trend assumptions (OLDEN; MØEN, 2022).

In the first difference, we compare outcomes for municipal schools in Ceará, exposed to the educational reform as a treatment group, and schools in the adjacent states that were not exposed to the reform as a control group. The second difference is the year the educational reform was implemented, i.e., after 2007, we consider treatment years. Our third difference comes from being above or below the median of our assignment variable[16] (SQMI) in 2007, pre-reform.

The third difference definition can be related to the DiD framework with dosage as highlighted by Callaway *et al.* (2024), Chaisemartin e d'Haultfoeuille (2024). In this scenario, we define our third difference as a binary dosage variable that divides schools with good or bad management practices within the DiD framework. This approach builds on the traditional DiD design, which evaluates the impact of the educational reform in Ceará. However, instead of employing a continuous dosage variable, we use a binary variable to capture heterogeneity in the effects of the reform.

In this context, the binary dosage or third difference is represented by the school management index before the reform, which reflects the quality of management practices at that time. This additional comparison layer enables us to

[16] For more information on the assigning mechanism, see Appendix A1

isolate the heterogeneity of the reform's impact, specifically for schools with good management practices before the reform. Both methods rely on the assumption of parallel trends, which ensures that, in the absence of the reform, schools with differing levels of pre-reform management quality would have followed similar trajectories, allowing the observed changes to be causally attributed to the reform intervention.

To set this model for 5th and 9th-grade cohorts, we constructed a pooled cross-section at the student level by municipal schools that appear every year in the *Prova Brasil/SAEB* sample in Ceará and border state, controlling for characteristics in 2007. The econometric specification is defined by:

$$Y_{ismt}^{5/9th} = \beta_0 + \beta_1 d_{09t} + \beta_2 S_m + \beta_3 Prog_{st=2007} + \beta_4 d_{09t} * S_m + \beta_5 d_{09t} * Prog_{st=2007} + \beta_6 S_m * Prog_{st=2007} + \beta_7 d_{09t} * Prog_{st=2007} * S_m + X'_{ist=2007}\beta_8 + \theta_m + \delta_t + \varepsilon_{ist} \tag{3.1}$$

Our coefficient of interest is β_7, representing the average within-school change in our outcome variables for students in schools with low management practices relative to students in schools with high management practices following the 2007 educational reform. $X'_{ist=2007}$ is a set of school characteristics in 2007 (pre-educational reform) that we use to control our results[17]. We use municipal (θ_c) and year (δ_t) fixed effects. Standard errors are clustered by municipality and presented in brackets.

The DDD approach helps us to isolate the causal impact of TA and RBF reforms on the educational outcomes of schools with good management practices in Ceará. This methodology leverages the temporal and spatial variations

[17] The controls for students are: white student, race not declared student, female student, student age, student per class; for school infrastructure: special needs facilities, computer lab, science lab, special education classroom, sports court, library, internet access; for teachers: female teacher percentage, white teacher percentage, race not declared teacher percentage, postgraduate teacher percentage, classes per teacher.

in implementing the reforms and the differences in school management quality measured by the SMQI. The analysis ensures a robust estimation of the reforms' impact on key outcomes by controlling for potential confounding factors and including municipality and time-fixed effects. In the Appendix, figure B2.1 presents the covariate balance for our sample before and after adjustment, and table B3.10 presents the results of the proficiency estimation without the entropy balance weight.

Using the SMQI as a binary variable instead of a continuous measure offers specific advantages in the context of this study, particularly in terms of interpretability and alignment with the study's goals. Treating SMQI as binary simplifies the analysis by categorizing schools into two distinct groups—those with good management practices and those without—allowing for a clear comparison of outcomes between these categories. This approach is especially useful when the goal is to evaluate the differential impact of reforms on schools that meet a predefined threshold of management quality, which aligns with the study's focus on the effects of pre-existing good practices.

Moreover, a binary treatment facilitates the communication of findings to policymakers and practitioners. Clearly identifying schools that fall above or below a specific management quality threshold makes the results more actionable, enabling targeted interventions. While a continuous approach might capture finer gradations in management quality, it could also introduce complexity that might obscure the practical implications of the findings, especially for decision-makers seeking straightforward criteria for resource allocation or policy adjustments.

Additionally, using SMQI as binary aligns with the institutional context of Ceará's educational reforms, where incentives and recognition (such as the PEN10) are often distributed based on clear performance thresholds. Thus, the binary categorization reflects the operational realities of the policy environment, ensuring

that the analysis remains relevant and grounded in the context of implementation. While a continuous approach could offer supplementary insights, the binary variable effectively addresses the primary research questions and maintains coherence with the study's objectives.

Unlike the traditional way of representing the estimation results, we aim to show the heterogeneity of the results over the years. To do that, we express the results in a two-by-two estimation, using the period pre-treatment and each year of the treatment. This representation is similar to an event study presented by Chaisemartin e d'Haultfoeuille (2024). The choice for this representation of the result is that instead of analyzing the aggregate effect of the policy, we can explore its implementation over the years.

Our identification strategy may face additional threats that we cannot fully address due to the lack of necessary data (BERTRAND *et al.*, 2004). For instance, we rely on a pooled cross-sectional dataset of students who took the *Prova Brasil/SAEB* test over multiple years. In this setup, we cannot ensure that students in the TA cohorts participate in the program for its entire duration. Specifically, if a significant number of fifth-grade students in Ceará in 2011 did not experience 2 to 3 years of the PAIC program—whether due to migration or failing to advance to fifth grade in 2010—this could introduce bias into our results.

To mitigate possible bias, we run a series of robustness checks on the DDD model that test different comparison groups, endogeneity tests, and common chocks. We also run a sensitive analysis following Roth (2022), Roth e Sant'Anna (2023), Rambachan e Roth (2023) to check the parallel trends since our pre-treatment period is limited duo the lack of data for school and student results before 2007 of *Prova Brasil/SAEB* test. Those results are presented in section 3.4.2.

3.4 Results

This section provides a detailed analysis of the estimated impact of schools with above-the-median management quality, as measured in 2007, on student performance in 5th and 9th grades. We examine how good management quality before implementing educational reforms in Ceará is associated with student outcomes and whether these effects vary between grade levels.

The subsequent sections present a series of robustness tests to validate the credibility of our findings. These tests assess whether the observed effects remain consistent across different analytical conditions, increasing confidence that the results are not driven by random variation or measurement error. In addition, we conducted endogeneity checks and tests for common shocks to determine whether our covariates exerted any significant influence over time. These additional analyses help ensure that the estimated effects are not confounded by omitted variables or external factors unrelated to the intervention.

We also examine the impact of schools with good management quality on the retention and abandonment of students who took the 5th and 9th grade tests over the years. We repeated the robustness test realized for proficiency; these results are in the appendix. Finally, we explore potential mechanisms that could explain why the above-median management quality in 2007 would influence student outcomes, investigating the pathways through which management practices could impact educational performance in these grade levels.

It is important to highlight that the *Prova Brasil/SAEB* test became universal for all schools in 2007. Before this, the tests were administered to a randomized sample of schools. As a result, we only have one pre-treatment period available, which serves as the baseline for analyzing the outcome results.

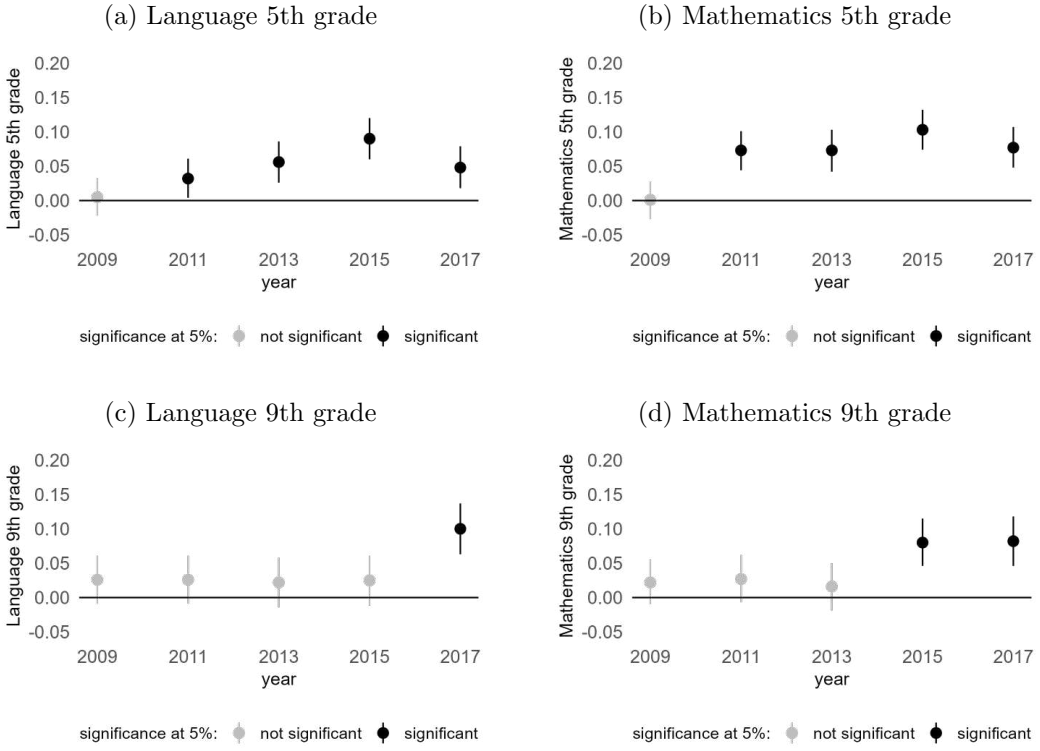
3.4.1 5th and 9th grade Proficiency Results

The educational reforms implemented in Ceará, particularly those involving redistributing resources based on municipalities' educational performance, have been widely discussed for their positive impact on student outcomes, especially in resource constrained contexts. Figure 7, presents the result of equation (3.1), which examines the performance of 5th and 9th-grade students in mathematics and language over the years in *Prova Brasil/SAEB*, provides a detailed view of the effects of these reforms in schools in Ceará that had SQMI above the median in 2007, pre-reform, against the border states.

The results for 5th grade (figures 7a, 7b) show substantial improvement over the period analyzed. The lack of results in 2009 is because it was the first year of the transfer from RBF. The mayors needed more time to improve education with the money, and the first technical assistance cohort did not do the test. Particularly from 2011, when students from the first cohort of the technical assistance program, which began in 2008 and focused on school management to improve student learning, took the exam after completing the entire elementary school cycle. Both results, language and mathematics, show a significant improvement in students‘ average scores that had an SQMI above the median in 2007, suggesting that schools with management practices above the median in Ceará were able to implement the interventions immediately, positively impacting students in foundational mathematics learning as well as in reading and writing skills.

Interestingly, the results have increased over the years, reaching the maximum difference in scores in 2015: 0.1 SDs for mathematics and 0.09 SDs for Languages. In 2017, the results decreased, primarily due to improvements in the municipalities' implementation practices in Ceará. Other states in Ceará began learning from the case and attempting to replicate similar policies.

Figure 7 – Proficiency Results for 5th and 9th grade



Note: Significance at 5 percent. This figure shows the impacts of good management practices on test scores for 5th and 9th grades in Ceará and borders states after the TA and RBF reform. Test scores are from *Prova Brasil/SAEB*, the national standardized exam undertaken every two years. The municipality controls are white student, race not declared student, female student, student age, student per class, special needs facilities, computer lab, science lab, special education classroom, sports court, library, internet access, female teacher percentage, white teacher percentage, race not declared teacher percentage, postgraduate teacher percentage, classes per teacher. By choice, the authors decided to omit the covariate results. Municipality-specific and time trends fixed-effects are included. Standard errors are clustered by municipality.

On the other hand, the results for 9th grade (figures 7c, 7d) also show improvements, but they are less pronounced than in the 5th grade; they also started to become significant in 2015 for mathematics and in 2017 for language. The results started to be significant in 2015 when the first cohort of the technical assistance program was in 9th grade and when the government expanded the program for the final years of primary school. The results for mathematics and language reached the maximum difference in scores in 2017, with 0.08 SDs for mathematics and 0.1

SDs for languages.

The lower results observed in the 9th grade compared to the 5th grade may be influenced by differences between primary and lower secondary education. Factors such as the later implementation of TA and the lack of distribution of RBF could have impacted these outcomes; the expenditure of these cycles is more prominent and delicate than in the primary years. It is also essential to consider other contextual factors, such as the widening gap between students from higher and lower socioeconomic backgrounds and racial gaps becoming more pronounced at this stage. The cumulative challenges students face over the years also become more evident in the 9th grade. Furthermore, this stage typically has a higher proportion of students with repeated grades, which may contribute to the overall results (ALVES; FERRÃO, 2019; JUNIOR *et al.*, 2021; NUNES *et al.*, 2023; CARNOY *et al.*, 2022).

These results indicate that while the reforms successfully strengthened basic skills, they could have been more effective in sustaining this progress as students moved to more complex subject levels. It can also be related to various factors, including the increasing complexity of the curriculum and the need for more specific interventions to maintain gains over time (BAKER, 2005; DARLING-HAMMOND, 2015). Additionally, the limited impact in 9th grade may be a problem of the framework design of the legislation with a focus on the primary years and reflect the need for differentiated pedagogical strategies and more targeted resources for the final years of elementary education.

The findings, particularly for the 5th grade, align with previous studies Shirasu *et al.* (2013a), Irffi *et al.* (2021), Silva (2021), Lautharte *et al.* (2021), Carneiro *et al.* (2022), demonstrating that redistributing resources based on educational performance, combined with technical assistance, can significantly enhance student outcomes. However, as noted by Brandão (2014a), Glewwe e Muralidharan

(2016), these policies often widen the gap between high- and low-performing schools, raising critical equity concerns.

Our results emphasize the dual impact of redistributive policies and school management quality. Performance-based resource allocation, when combined with above-median management, leads to significant improvements in 5th and 9th-grade outcomes. This approach effectively rewards higher-performing schools and incentivizes continued progress. However, it also disproportionately benefits advantaged institutions, deepening disparities with lower-performing schools.

The contrast between school groups highlights a fundamental trade-off embedded in the design of RBF policies. While these policies effectively drive performance improvements by rewarding success, they may inadvertently disadvantage lower-performing schools that struggle to meet performance thresholds. This outcome reflects a structural tension: addressing these disparities would require reallocating greater resources to underperforming schools. However, doing so could undermine the core principle of results-based financing, which ties support to demonstrated outcomes. Navigating this tension calls for careful policy calibration to balance incentives for excellence with mechanisms that promote equity and support capacity-building in more challenged contexts.

3.4.2 Robustness Check

3.4.2.1 Parallel Trends - Test and Sensitive

Since we only have one pre-treatment period in this DDD framework, addressing the required parallel trends assumption (OLDEN; MØEN, 2022) becomes challenging because we can not directly observe trends across multiple pre-treatment periods. However, we implement several strategies to minimize and adjust our model.

First, we control our covariate variables using the pre-treatment period (2007). This will not solve the issue entirely but will help mitigate biases due to initial differences between our treatment and control group. Second, we use these variables in 2007 to calculate weights that adjust schools' characteristics before treatment with SQMI above or below median through Hainmueller (2012). Third, we did robustness results testing alternative border definitions (section 3.4.2.3) and also an endogeneity and common chocks test to examine if the covariates had some influence over the year (section 3.4.2.2).

Finally, we conducted a sensitivity analysis to assess our results' robustness further. Recent studies have raised concerns about the limited statistical power of traditional methods used to test the parallel trends assumption in difference-in-differences designs (RAMBACHAN; ROTH, 2023; ROTH, 2022; ROTH; SANT'ANNA, 2023; FREYALDENHOVEN *et al.*, 2019). These findings suggest that a non-significant result from a pre-treatment trend test does not necessarily confirm that the treated and control groups would have followed parallel trends without treatment. As noted by Roth (2022), standard confidence intervals often suffer from substantial under-coverage when researchers rely on conventional pre-trend tests, which frequently lack validity. This problem becomes more critical because an inaccurate pre-treatment trend test can bias the estimation of post-treatment effects. Given these concerns, our sensitivity analysis accounts for potential violations of the parallel trends assumption to ensure that our inferences remain credible even under more conservative and robust specifications. Rambachan e Roth (2023) suggested a technique to improve the robustness of post-treatment effect analyses by doing parallel trend sensitivity tests in response to these problems. In order to evaluate how sensitive treatment impact estimates are to departures from the anticipated parallel trend, their method entails reconstructing the model to include a non-parallel pre-treatment trend. Techniques like bounding relative

magnitudes and adding smoothing limitations are part of this methodology. This analysis can be formalized by stipulating that the post-treatment violation of parallel trends should not exceed a constant M, which is larger than the maximum violation of parallel trends observed during the pre-treatment period.

We investigate the sensitivity of parallel trends by following Rambachan e Roth (2023) to test the parallel trends. We choose particular Mbar-values for every estimation, and Figure B2.4 displays the outcomes. We note that the "breakdown" value for a significant effect varies between 0.17 and 0.22 SD (depending on the estimation) using smoothness restrictions, i.e., imposing that the slope of difference in trends changes by no more than M between periods. This means that we can reject a null effect unless we are willing to allow for a linear extrapolation across consecutive periods to be off by more than 0.22 S.D points.

We also apply the value of M ranging from 0.3 to 0.5, which imposes a constraint that any post-treatment violation of the parallel trends assumption must not exceed the most severe violation observed during the pre-treatment period (measured between consecutive time points). Our analysis shows that the "breakdown value" for maintaining a statistically significant effect occurs at approximately $M \approx 0.5$. This finding indicates that our results remain robust if post-treatment deviations from parallel trends do not surpass the most significant deviation identified before the intervention. The results of this sensitivity analysis are presented in Figure B2.5.

Analyzing the results in Figure 7, it is observed that the maximum deviation from the post-trend test occurred in 2015, and it is smaller than M that we find in the estimation. Therefore, according to the approach of Rambachan e Roth (2023), the post-treatment parallel trends are consistent with the pre-trend test, ensuring a low probability of violating the parallel trends hypothesis.

3.4.2.2 Endogeneity Test and Common Chocks

To verify the presence of endogeneity, Wing *et al.* (2018), Carneiro *et al.* (2022) use a comprehensive approach that involves performing estimations similar to equation (3.1) without controls but using the covariates employed in the original estimation as dependent variables. Under the null hypothesis, the test assesses whether the covariates considered exogenous remain unaffected by the treatment. Additionally, the test examines whether both groups responded similarly to exogenous changes in the post-treatment period (common shocks).

Unlike the primary regression, which relies on covariates fixed in 2007, this test examines the evolution of these variables over time, allowing for the identification of dynamic patterns and new insights. Additionally, we include the total number of students by school level—specifically for primary and lower secondary education—to detect any changes in school enrollment that may reflect shifts in school composition. By incorporating this variable, we aim to explore whether enrollment patterns acted as a potential change mechanism and provide a more nuanced understanding of the reform's broader impact on school dynamics.

To implement the test and verify whether both groups responded similarly to exogenous changes in the post-treatment period, we estimated all equations simultaneously for the covariates that we use in our primary estimation, i.e., we do not use the school enrollment variable in this model, considering each treatment and indicator, using the seemingly unrelated regression (SUR) method. This collaborative procedure allows for jointly testing the hypothesis of changes in covariates after the treatment (ZELLNER, 1962). The results in Table 8 present the test for endogeneity and common shocks in the post-treatment period.

Table 8 – Endogeneity test and Common Shocks test for Primary and Lower Secondary Education

	Primary Education					Lower Secondary Education				
	09/07	11/07	13/07	15/07	17/07	09/07	11/07	13/07	15/07	17/07
Covariates	4.770	14.320	22.350	19.540	22.380	6.000	12.340	12.290	10.730	17.190
(Global Test p-value)	(0.996)	(0.708)	(0.171)	(0.359)	(0.215)	(0.997)	(0.829)	(0.832)	(0.905)	(0.510)
White Students	-0.007	-0.015	-0.016	-0.018	-0.018	-0.002	-0.008	-0.010	-0.012	-0.025
	(0.009)	(0.011)	(0.012)	(0.013)	(0.014)	(0.009)	(0.011)	(0.011)	(0.013)	(0.014)
Race Not Declared Students	0.037	0.037	0.046	0.054	0.034	0.018	0.056	0.051	0.039	0.049
	(0.031)	(0.031)	(0.031)	(0.033)	(0.033)	(0.027)	(0.031)	(0.031)	(0.032)	(0.033)
Female Student	0.006	0.011	0.018	0.010	0.009	-0.004	-0.004	-0.004	-0.004	0.000
	(0.005)	(0.008)	(0.011)	(0.006)	(0.006)	(0.004)	(0.005)	(0.005)	(0.005)	(0.005)
Students per Class	-0.430	-0.620	0.034	-0.094	-0.002	-0.064	-0.334	-0.055	-0.292	-1.075
	(0.676)	(0.681)	(0.675)	(0.677)	(0.683)	(0.643)	(0.682)	(0.681)	(0.693)	(0.712)
Student Age	0.174	0.132	0.244	0.316	0.309	-0.047	-0.165	-0.309	-0.273	-0.334
	(0.201)	(0.199)	(0.201)	(0.206)	(0.213)	(0.162)	(0.171)	(0.174)	(0.181)	(0.189)
Special Needs Facilities	-0.005	0.015	0.084	0.116	0.100	0.018	-0.034	-0.064	-0.052	-0.097
	(0.057)	(0.064)	(0.066)	(0.067)	(0.067)	(0.061)	(0.069)	(0.071)	(0.073)	(0.074)
Computer Lab	0.035	0.077	0.019	-0.008	0.107	0.012	-0.038	0.004	0.034	0.054
	(0.064)	(0.064)	(0.061)	(0.066)	(0.071)	(0.067)	(0.066)	(0.066)	(0.069)	(0.076)
Science Lab	0.000	-0.003	-0.031	-0.034	-0.032	0.003	-0.001	-0.015	-0.022	-0.006
	(0.026)	(0.028)	(0.029)	(0.028)	(0.029)	(0.032)	(0.035)	(0.038)	(0.039)	(0.041)
Special Education Classroom	0.043	0.080	0.155	0.054	0.036	-0.003	-0.092	-0.092	0.016	-0.059
	(0.045)	(0.060)	(0.095)	(0.066)	(0.066)	(0.049)	(0.065)	(0.069)	(0.071)	(0.071)
Sports Court	0.000	-0.009	0.018	0.022	0.056	0.000	0.068	0.075	0.076	0.020
	0.000	(0.087)	(0.090)	(0.091)	(0.092)	0.000	(0.083)	(0.081)	(0.079)	(0.080)
Library	0.061	0.092	0.077	0.066	0.069	-0.051	-0.006	-0.040	-0.011	-0.016
	(0.063)	(0.065)	(0.064)	(0.065)	(0.065)	(0.057)	(0.061)	(0.060)	(0.062)	(0.065)
Internet Access	0.034	-0.007	0.030	0.010	0.035	0.068	0.022	-0.007	0.056	0.001
	(0.065)	(0.063)	(0.062)	(0.060)	(0.059)	(0.069)	(0.067)	(0.067)	(0.066)	(0.067)
Female Teacher Percentage	-0.018	-0.014	0.010	-0.022	-0.024	0.004	0.016	0.028	0.018	0.024
	(0.016)	(0.016)	(0.017)	(0.017)	(0.017)	(0.015)	(0.016)	(0.017)	(0.017)	(0.019)
White Teacher Percentage	-0.001	0.010	0.001	-0.021	-0.092	0.012	0.007	0.020	-0.004	-0.027
	(0.019)	(0.020)	(0.020)	(0.020)	(0.053)	(0.019)	(0.020)	(0.021)	(0.021)	(0.025)
Race Not Declared Teacher Percentage	0.091	-0.047	0.104	0.100	0.091	-0.042	-0.053	-0.013	-0.007	-0.012
	(0.063)	(0.034)	(0.074)	(0.063)	(0.063)	(0.033)	(0.034)	(0.035)	(0.035)	(0.036)
Graduate Teacher Percentage	-0.006	0.046	0.022	0.003	0.024	-0.005	0.000	-0.002	-0.025	-0.017
	(0.026)	(0.026)	(0.025)	(0.026)	(0.026)	(0.022)	(0.022)	(0.022)	(0.023)	(0.025)
Postgraduate Teacher Percentage	0.001	0.030	-0.010	0.014	0.009	-0.010	-0.021	-0.045	-0.056	-0.063
	(0.022)	(0.023)	(0.024)	(0.025)	(0.026)	(0.022)	(0.023)	(0.025)	(0.036)	(0.048)
Classes per Teacher	0.164	0.126	0.181	0.378	0.374	-0.021	-0.237	-0.475	-0.354	-0.332
	(0.202)	(0.205)	(0.206)	(0.202)	(0.209)	(0.218)	(0.231)	(0.331)	(0.234)	(0.245)
Student Enrollment	10.652	6.663	11.425	10.396	5.670	3.750	5.869	13.779	7.508	4.526
	(23.907)	(23.330)	(23.194)	(23.164)	(23.478)	(26.124)	(26.130)	(26.668)	(27.305)	(28.390)

Notes: *** denotes significance at 1 percent, ** at 5 percent, and * at 10 percent level. H_0: Existence of endogeneity and common shocks. This table presents the endogeneity test results for primary and lower secondary school years, using the covariates as the outcome variable of the equation (3.1) without controls. The common shocks were measured by the global test jointly evaluating all covariates we used in estimation, with p-values shown in parentheses. We Also realized an endogeneity test with student enrollment at each school level. The results indicate no systematic changes in the covariates between groups, supporting the validity of the homogeneity and common shocks assumptions.

The hypothesis tested is that the covariates do not change systematically between treated and control groups after the treatment. Notably, the global test fails to reject the null hypothesis for all covariates. Therefore, the tests indicate that the proposed estimations meet the assumptions required by at least one method.

We also did not find results in school enrollment. As a result, it can be inferred that the outcomes produced by these estimations reflect the average effect of schools that demonstrated good management practices prior to implementing the RBF and TA on individual student learning.

3.4.2.3 Robustness Results - Alternative Borders

In addition, as a robustness check on school proximity to border effects and similar in spirit to Costa e Carnoy (2015), Lautharte *et al.* (2021), Carneiro e Irffi (2023), we considered alternative definitions of the borders (i.e., re-estimate in equation (3.1), but instead of using the entire sample, we divide the process into four different equations. We exclude one of the states used as a border reference in each equation). Figures 8, 9: 5th grade Results, and Figures 10, 11: 9th Grade results.

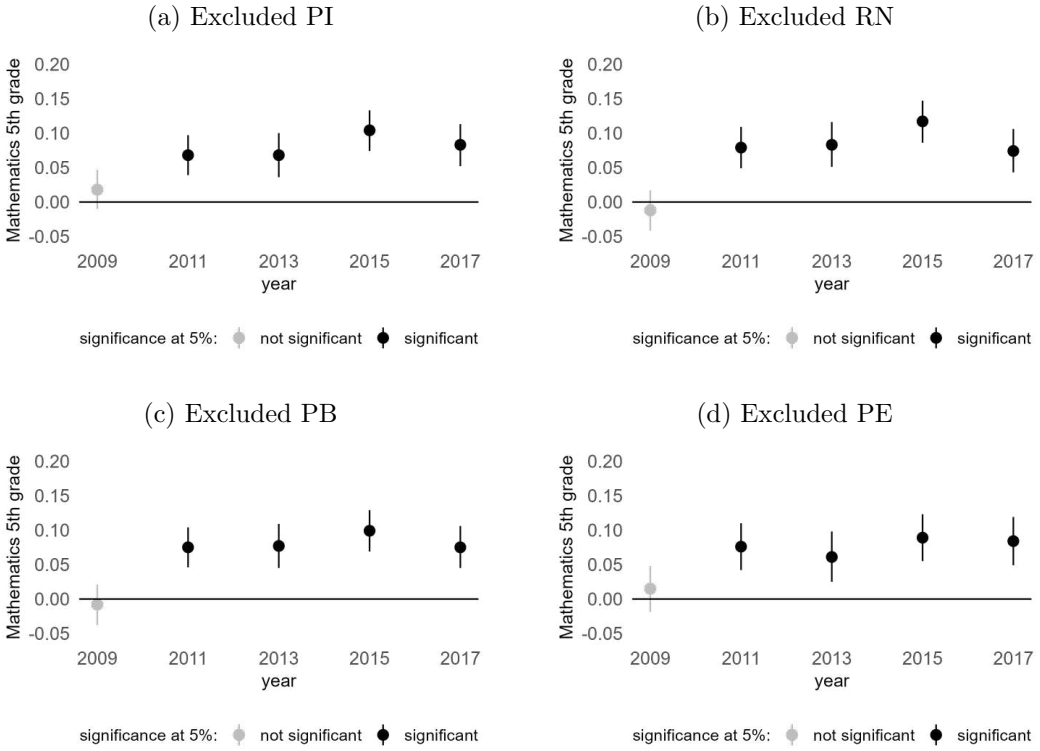
The overall improvement in students' outcomes with standardized test results is excellent and robust when any border state is outstanding compared to the main results. These results indicate a trend of border effect across Ceará but show no single state driving the positive and significant impacts. The conclusion that the change improvement is present only when SQMI exceeds its median confirms our hypothesis and indicates the necessity of good management for successfully introducing and implementing educational reforms.

Figures **??** and **??** present a baseline analysis of how excluding individual states affects 5th-grade performance in standardized tests. Even when specific states are excluded from the sample, the results consistently show that schools with stronger management practices before Ceará's educational reform could effectively implement the new policies. These schools achieved more substantial and rapid improvements in student outcomes.

The observed pattern—marked improvements beginning in 2011, peaking

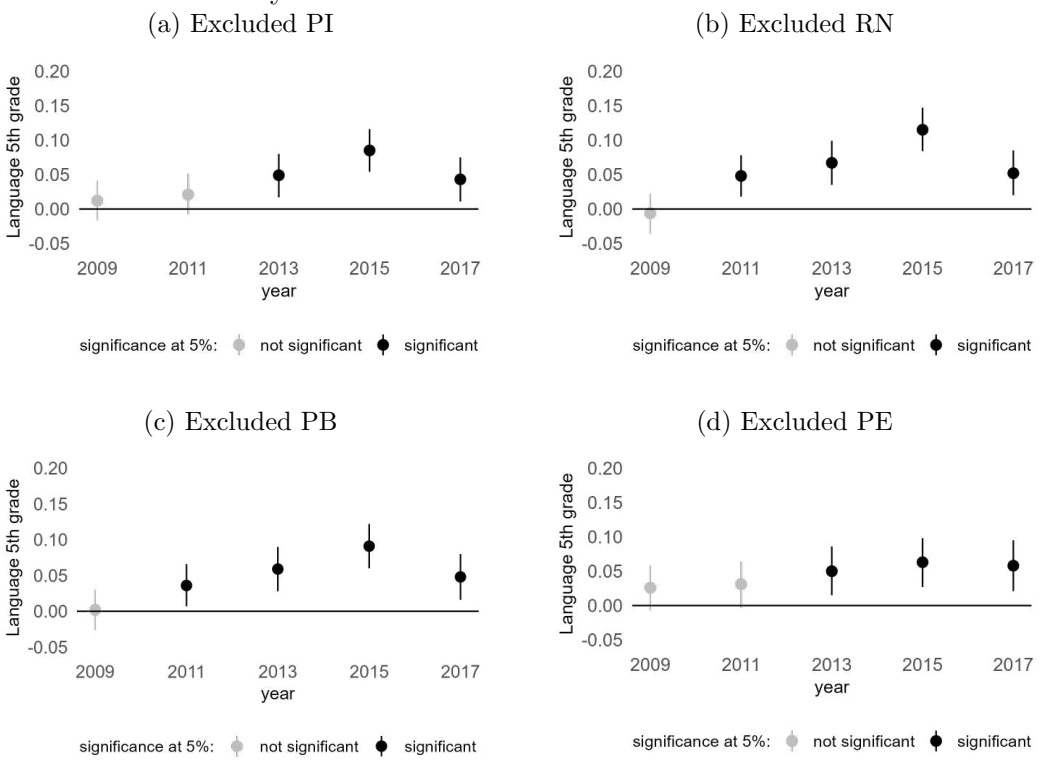
in 2015, and declining slightly by 2017—remains consistent across different state exclusion scenarios. This consistency reinforces the robustness of the main findings. It supports the conclusion that effective school management is critical in enabling the successful implementation of educational reforms and sustaining improved learning outcomes.

Figure 8 – Proficiency Results 5th grade Mathematics - Robustness: Excluding one border state from analysis



Note: Significance at 5 percent. This figure shows the impacts of good management practices on test scores for 5th grade in Ceará and border states after the TA and RBF reform, excluding one border state in each estimation. Test scores are from *Prova Brasil/SAEB*, the national standardized exam undertaken every two years. The municipality controls are white student, race not declared student, female student, student age, student per class, special needs facilities, computer lab, science lab, special education classroom, sports court, library, internet access, female teacher percentage, white teacher percentage, race not declared teacher percentage, postgraduate teacher percentage, Classes per teacher. Municipality-specific and time trends fixed-effects are included. Standard errors are clustered by municipality.

Figure 9 – Proficiency Results 5th grade Language - Robustness: Excluding one border state from analysis



Note: Significance at 5 percent. This figure shows the impacts of good management practices on test scores for 5th grade in Ceará and border states after the TA and RBF reform, excluding one border state in each estimation. Test scores are from *Prova Brasil/SAEB*, the national standardized exam undertaken every two years. The municipality controls are white student, race not declared student, female student, student age, student per class, special needs facilities, computer lab, science lab, special education classroom, sports court, library, internet access, female teacher percentage, white teacher percentage, race not declared teacher percentage, postgraduate teacher percentage, Classes per teacher. Municipality-specific and time trends fixed-effects are included. Standard errors are clustered by municipality.

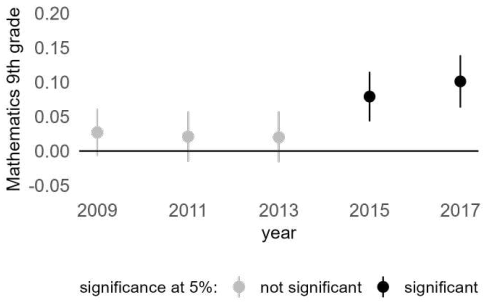
Figures 10, 11, similar to Figures 8, 9, examine the changes in standardized results when excluding each border state in the equation (3.1), but in 9th grade. The sustained improvements, especially after 2013, highlight the main findings. The consistent results across different scenarios indicate that the benefits of such policies are broadly applicable. However, they may still increase disparities between well-managed and less well-managed schools (GLEWWE; MURALIDHARAN, 2016;

BRANDÃO, 2014a; SILVA, 2021; VELOSO; BARBOSA, 2021).

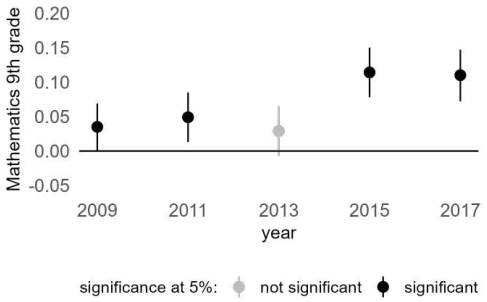
Notably, when the border with Rio Grande do Norte (RN) is excluded, the results become significant in all years of estimation in both tests, except for 2013 and 2009 for language. This finding, while isolated, underscores the robustness of our main conclusions. In essence, the consistent and robust results affirm that effective school management before the educational reform in Ceará was instrumental in the success of these schools. The improvements in student performance in mathematics and language are consistent across different scenarios, underscoring the importance of early implementation of management practices in leading this process and achieving and sustaining educational gains ahead of other schools below the median in SQMI in Ceará and frontier states.

Figure 10 – Proficiency Results 9th grade Mathematics - Robustness: Excluding one border state from analysis

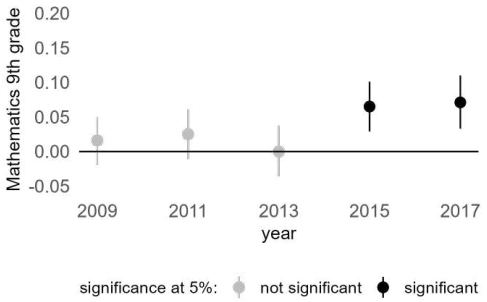
(a) Excluded PI



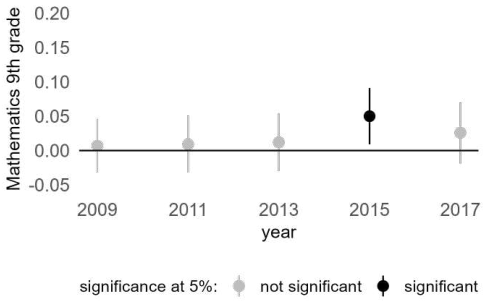
(b) Excluded RN



(c) Excluded PB

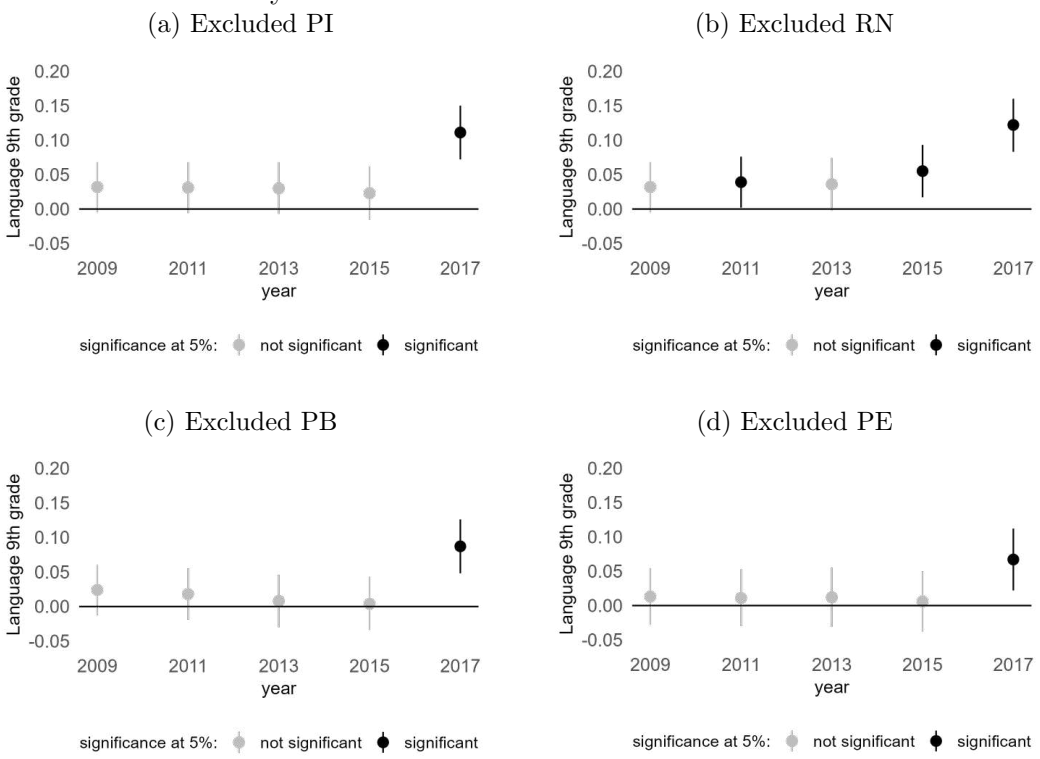


(d) Excluded PE



Note: Significance at 5 percent. This figure shows the impacts of good management practices on test scores for 9th grade in Ceará and border states after the TA and RBF reform, excluding one border state in each estimation. Test scores are from *Prova Brasil/SAEB*, the national standardized exam undertaken every two years. The municipality controls are white student, race not declared student, female student, student age, student per class, special needs facilities, computer lab, science lab, special education classroom, sports court, library, internet access, female teacher percentage, white teacher percentage, race not declared teacher percentage, postgraduate teacher percentage, Classes per teacher. Municipality-specific and time trends fixed-effects are included. Standard errors are clustered by municipality.

Figure 11 – Proficiency Results 9th grade Language - Robustness: Excluding one border state from analysis



Note: Significance at 5 percent. This table shows the impacts of good management practices on test scores for 9th grade in Ceará and border states after the TA and RBF reform, excluding one border state in each estimation. Test scores are from *Prova Brasil/SAEB*, the national standardized exam undertaken every two years. The municipality controls are white student, race not declared student, female student, student age, student per class, special needs facilities, computer lab, science lab, special education classroom, sports court, library, internet access, female teacher percentage, white teacher percentage, race not declared teacher percentage, postgraduate teacher percentage, Classes per teacher. Municipality-specific and time trends fixed-effects are included. Standard errors are clustered by municipality.

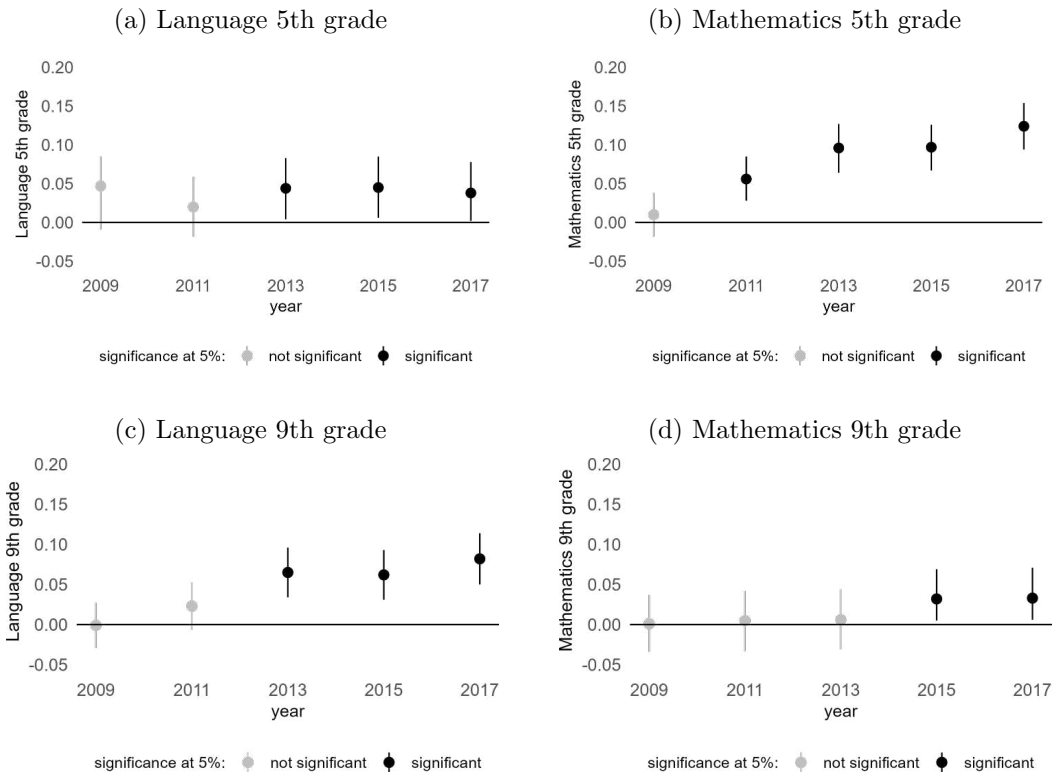
Additionally, we realized a similar exercise to Petterini e Irffi (2013), Irffi *et al.* (2021) that used Bahia as a control group. The authors argue that the state of Bahia had police similar to the older police of Ceará (1996 legislation) and socioeconomic characteristics similar to those of the municipalities of Ceará. Figure 12.

Figures 12a, 12b present the results for 5th grade. As well as Petterini e

Irffi (2013), the results are significant and positive after 2011 for language and after 2009 for mathematics, confirming that the policy changes were able to transform test scores quickly for schools with better management practice. Although we calculate differently from Petterini e Irffi (2013), we calculate the magnitude over the years, Bahia confirms our main result.

Figures 12c, 12d present the results for 9th grade. Petterini e Irffi (2013), Irffi *et al.* (2021) did not calculate the results for 9th grade. In contrast to our main results, the results for language are also positive and significant for 2013 and 2015. For mathematics, the results are still significant for 2015 and 2017. Compared to our main results, all panels had a similar or less effect than our main result, except for mathematics for 5th grade in 2017. These results confirm our finding that schools with better school management practices in 2007 (before the implementation of TA and RBF) in Ceará had better educational results after the years.

Figure 12 – Proficiency Results 5th and 9th grade - Robustness: Using Bahia students as control



Note: Significance at 5 percent. This figure shows the impacts of good management practices on test scores for 5th and 9th grades in Ceará and borders states after the TA and RBF reform. Test scores are from *Prova Brasil/SAEB*, the national standardized exam undertaken every two years. The municipality controls are white student, race not declared student, female student, student age, student per class, special needs facilities, computer lab, science lab, special education classroom, sports court, library, internet access, female teacher percentage, white teacher percentage, race not declared teacher percentage, postgraduate teacher percentage, classes per teacher. By choice, the authors decided to omit the covariate results. Municipality-specific and time trends fixed-effects are included. Standard errors are clustered by municipality.

3.4.3 5th and 9th grade Retention and Abandonment

Previously, the results pointed out significant results for students' proficiency in language and mathematics for 5th and 9th. On the other hand, what is the impact of schools with good management quality on retaining and abandoning students who took the 5th and 9th grade tests over the years? To answer this

question, we use equation (3.1), but instead of having proficiency as an outcome, we use two questions from the student questionnaire that was done the *Prova Brasil/SAEB* in the 5th and 9th. The first question addresses whether the student retained one or more years in each cycle, and the second question is if the student abandoned the school in one or more years in each circle. In this case, our outcome is a binary variable that is equal to one if the student has retained/ abandoned school or zero otherwise.

It is essential to note that school retention refers to requiring a student to repeat a grade level due to insufficient academic progress. School abandonment occurs when, at the end of the school year, a student stops attending classes (without being transferred) but returns to school the following year (FERREIRA *et al.*, 2022).

The results presented in Figure 13 indicate that the impacts of good management practices, such as the TA and RBF reforms, on retention and abandonment rates are limited across both primary and lower secondary grades. In primary education (Figures 13a, 13b), retention and abandonment rates range from 1 to 4 percent. In contrast, school retention had significant results after 2009, and school abandonment only started to be significant after 2013.

These findings suggest that while localized improvements occurred, the reforms had some influence on retention and abandonment in these grades. This is consistent with findings in Brazilian contexts, such as those discussed by Alves *et al.* (2017), who highlight that structural reforms often have limited immediate effects on primary school outcomes without accompanying measures targeting individual student needs.

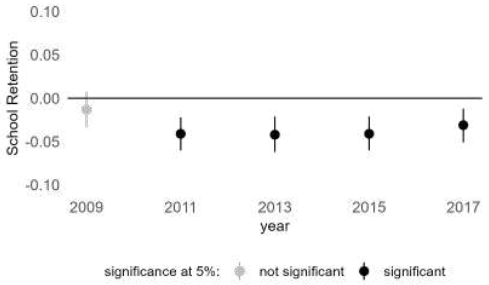
The trends in lower secondary education (Figures 13c, 13d) are similar, with retention and abandonment rates, but they are not significant over the periods. The limited effects in this stage may reflect the prominent challenges

faced by secondary students, such as widening socioeconomic disparities and the cumulative impact of earlier learning gaps, as noted by Cury (2008) in the broader Brazilian educational context. These gaps become increasingly apparent at this stage, particularly for students from lower socioeconomic backgrounds.

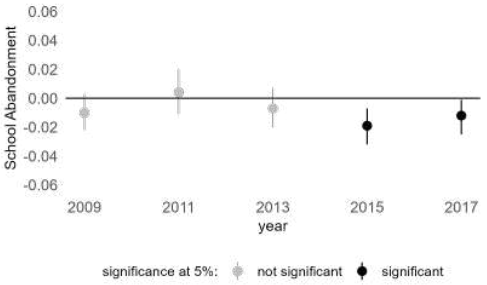
In Ceará, specifically, studies such as those by Vieira *et al.* (2019) emphasize that while the state has implemented innovative management practices, including its nationally recognized TA, challenges persist in addressing secondary education outcomes. This aligns with the data in the figure, showing that 9th-grade students face systemic barriers that the TA and RBF reforms alone are insufficient to overcome.

Figure 13 – Retention and abandonment for 5th and 9th grade

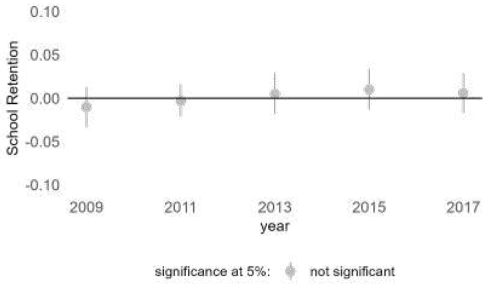
(a) School Retention in primary years



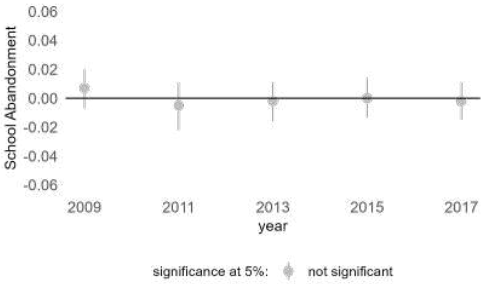
(b) School Abandonment in primary years



(c) School Retention in lower secondary years



(d) School Abandonment in lower secondary years



Note: Significance at 5 percent. This figure shows the impacts of good management practices on retention and abandonment for 5th and 9th grades in Ceará and border states after the TA and RBF reform. Failure in school and dropout are questions for students from *Prova Brasil/SAEB*, the national standardized exam undertaken every two years. The municipality controls are white student, race not declared student, female student, student age, student per class, special needs facilities, computer lab, science lab, special education classroom, sports court, library, internet access, female teacher percentage, white teacher percentage, race not declared teacher percentage, postgraduate teacher percentage, classes per teacher. By choice, the authors decided to omit the covariate results. School retention refers to requiring a student to repeat a grade level due to insufficient academic progress. School abandonment occurs when, at the end of the school year, a student stops attending classes (without being transferred) but returns to school the following year. Municipality-specific and time trends fixed-effects are included. Standard errors are clustered by municipality.

Additionally, the high proportion of grade retention and repetition in lower secondary education, highlighted by Cury (2008), Alves *et al.* (2017), Barros *et al.* (2021), further complicates progress in these grades. The higher student repetition rate reflects accumulated learning difficulties and correlates strongly with

abandonment rates, particularly in more disadvantaged regions. The findings in this study reaffirm the need for more targeted and complementary interventions to address retention and abandonment challenges, especially in lower secondary grades, where abandonment and dropout risks are higher.

The analysis of results for primary education underscores the significant impact of good management practices on retention and abandonment rates. Schools with high management quality under the SMQI framework demonstrated a notable reduction in grade repetition and school abandonment, particularly after TA and RBF reforms were introduced. These findings align with studies by Alves *et al.* (2017) and Barros *et al.* (2021), highlighting the critical role of targeted interventions in addressing inefficiencies in primary education. Specifically, retention rates showed significant improvements from 2011 onward, while abandonment rates exhibited positive changes starting in 2013, suggesting a gradual but meaningful shift in outcomes due to the reforms.

However, transitioning to the results for lower secondary education, the impact of the same reforms diminishes. This divergence highlights the systemic challenges faced by secondary education, including more pronounced socioeconomic disparities and the cumulative effects of learning gaps, as discussed by Cury (2008) and Vieira *et al.* (2019). These differences suggest that while TA and RBF reforms provided a solid foundation for improving early educational outcomes, they were less effective in addressing the complexities of secondary education. Bridging this gap between primary and secondary results requires a continuation of effective management practices and additional support measures tailored to the unique needs of secondary students.

This analysis underscores the necessity of complementing management reforms with systemic interventions to achieve equitable outcomes across all educational levels by contextualizing these findings within the broader educational

landscape.

These results suggest that while management reforms like TA and RBF may provide a framework for improvement, their implementation had substantial challenges for lower secondary grades. Besides, we found some significant results for presentation and abandonment for lower primary grades, but we did not find any significant results for lower secondary grades. Future policy should consider integrating these reforms with broader educational support measures to tackle disparities and effectively reduce retention, abandonment, and dropout rates.

3.5 Mechanism

The SQMI comprises seven topics, each one detailed in Table B3.11. To explain the previous results, we explore each topic as a potential channel for our findings. These topics analyze school management processes, focusing on the Standardization of Instructional Processes, Personalizing of Instructions and Learning, Adopting educational best practices, Performance Review, Promoting High Performers, Managing Talent, and Attracting Talent/ Creating a Distinctive Employee Value Proposition.

To achieve that, we run the same procedure described in 3.3.1.1 and divide the schools in our database in the median of each topic, given 1 (one) if they are above the median in 2007 or 0 c.c. We estimate a model similar to equation (3.1) but replace our high enforcement variable, i.e., SMQI, with each dummy of a topic in SQMI.

The results presented in Table 9 explain the possible channels in the results of standardized tests in 5th grade. Regarding mathematics, managing talent, promoting high performance, attracting talent/creating a distinctive employee value proposition, and adopting educational best practices stand out significantly across all the years analyzed. These results are aligned with the literature, particularly

with studies of Bloom *et al.* (2015), Leaver *et al.* (2019), highlighting the importance of these practices in improving school performance. These authors suggest that schools with better talent management practices, such as hiring and retaining qualified teachers, tend to have students with better academic outcomes. For instance, in 2015, attracting talent and adopting educational best practices had an significant positive impact, with 0.11 SDs and 0.15 SDs, respectively, more prominent than the results found in the central estimation (0.10 SDs). The results increased for most of them over the years, getting the highest point in 2015 for that topic in mathematics.

However, performance reviews proved detrimental to mathematics outcomes. This results suggest that if performance reviews are inadequately implemented or perceived negatively, they can demotivate teachers and create a less collaborative environment, directly impacting student performance. Personalization of Instruction and Learning had a small, significant, and positive impact only from 2013 to 2015, not keeping up with the other positive results. On the contrary, standardization of instructional processes had a significant effect after 2011 and, in 2017, had the most significant impact (0.098 SDs), indicating that consistency in teaching methods can substantially benefit learning in mathematics instead of personalization methods of learning.

In language scores for 5th, adopting educational best practices and attracting talent/creating a distinctive employee value proposition also emerged as crucial factors, with positive and significant impacts over the years, especially after 2011, particularly in 2015, 0.12 SDs., and 0.1 SDs, respectively. These results indicate that an attractive work environment with the adoption of best practices is crucial for ensuring high language performance. One possible explanation is due to the non-implementation of legislation that includes the 9th grade.

In contrast, similar to mathematics, performance reviews showed nega-

tive and significant impacts on language. In 2017, as observed, we had a negative impact of 0.04 SDs. Promoting high performance had small positive and significant results between 2011 and 2013, as personalization of instruction and learning had a small positive and significant result in 2015. Those results demonstrated the importance of a clear and consistent teaching structure for language learning and improvement in score tests.

Table 9 – Mechanism using 5th grade results

	Mathematics					Language				
	07/09	07/11	07/13	07/15	07/17	07/09	07/11	07/13	07/15	07/17
Personalizing of Instruction and Learning	0.004	-0.013	0.034**	0.028*	-0.017	-0.021	-0.035**	0.010	0.033**	-0.011
	(0.014)	(0.015)	(0.016)	(0.015)	(0.015)	(0.014)	(0.015)	(0.015)	(0.015)	(0.016)
Performance Review	-0.032**	-0.001	-0.074***	-0.032**	-0.104***	-0.014	-0.035**	-0.045***	-0.033**	-0.084***
	(0.014)	(0.014)	(0.016)	(0.015)	(0.015)	(0.014)	(0.015)	(0.015)	(0.015)	(0.016)
Managing Talent	0.096***	0.037**	0.065***	0.074***	0.102***	0.054***	0.033**	0.061***	0.046***	0.087***
	(0.016)	(0.017)	(0.018)	(0.017)	(0.017)	(0.016)	(0.017)	(0.018)	(0.018)	(0.018)
Promoting High Performers	0.040***	0.075***	0.064***	0.054***	0.053***	0.015	0.041***	0.028*	0.022	0.027
	(0.015)	(0.015)	(0.017)	(0.015)	(0.016)	(0.015)	(0.015)	(0.016)	(0.016)	(0.017)
Attracting Talent/Creating a Distinctive Employee Value Proposition	0.057***	0.118***	0.103***	0.119***	0.110***	0.059***	0.104***	0.089***	0.101***	0.080***
	(0.014)	(0.014)	(0.016)	(0.015)	(0.015)	(0.014)	(0.015)	(0.015)	(0.015)	(0.016)
Standardization of Instructional Processes	-0.061***	0.072***	0.067***	0.064***	0.098***	-0.039***	0.042***	0.075***	0.039**	0.066***
	(0.014)	(0.014)	(0.016)	(0.015)	(0.015)	(0.014)	(0.015)	(0.015)	(0.015)	(0.016)
Adopting Educational Best Practices	0.032**	0.113***	0.130***	0.156***	0.092***	0.012	0.071***	0.092***	0.123***	0.058***
	(0.014)	(0.014)	(0.016)	(0.015)	(0.015)	(0.014)	(0.015)	(0.015)	(0.015)	(0.016)
Controls	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Year + Municipality F.E	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Municipality Cluster	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

Notes: *** denotes significance at 1 percent, ** at 5 percent, and * at 10 percent level. This table shows the impacts of each component of the management index test scores for 5th grade. Test scores are from *Prova Brasil/SAEB*, the national standardized exam undertaken every two years. The school controls are white student, race not declared student, female student, student age, student per class, special needs facilities, computer lab, science lab, special education classroom, sports court, library, internet access, female teacher percentage, white teacher percentage, race not declared teacher percentage, postgraduate teacher percentage, classes per teacher. By choice, the authors decided to omit the covariate results. Municipality-specific and time trends fixed-effects are included. Standard errors are clustered by municipality.

The results in Table 9 express the importance of well-planned and implemented school management in Ceará before 2007. Notably, adopting educational best practices and attracting talent/creating a distinctive employee value proposition also show that they are crucial for the results in mathematics and language.

However, it is essential to review the implementation of specific topics, like performance review. Hwa e Leaver (2021) argue that this topic, when used punitively or without constructive feedback, can demotivate teachers and, consequently, worsen student performance.

Similar to the exercise in Table 9, we do the same process but using the results in 9th grade; these results are available in Table 10. Performance reviews still had negative and significant effects on language and mathematics. Unlike 5th-grade results, personalization of instruction and learning became positive and significant, especially after 2015, when the technical assistance program worked for three years. The results in 2017 for this topic were 0.1 SDs in mathematics and 0.06 for language; the results in 2015 were both negative and significant, suggesting an adjustment between this test so that the results reversed the sign while remaining significant.

In mathematics, promoting high performers has changed perspective, especially from 2015, when the first cohort that underwent TA did the test. The results in 2015 were 0.06 SDs, and in 2017, they were 0.14 SDs, both significant, indicating that this topic, for schools that had this practice in 2007, more than doubled between these years. These results align with the literature, such as the studies of Hwa e Leaver (2021), which suggest that fostering a culture of excellence within schools, where high performance is encouraged and recognized, can substantially improve academic outcomes.

It is interesting to note that some topics were significant in 2015 but not in 2017, like the standardization of instructional processes and the adoption of educational best practices, sporting the conclusions of Bloom *et al.* (2015), Leaver *et al.* (2022), emphasizing that schools with management practices, tend to achieve better results and Glewwe e Muralidharan (2016) that when well implemented, standardization ensures that all students have access to high-quality education,

regardless of the school they attend. Conversely, attracting talent, creating a distinctive employee value proposition, and managing talent had no significance in 2015; however, they became significant in 2017, showing that the schools above the median in 2007 for those topics improved in this period.

Analyzing language outcomes from table 10, practices such as promoting high performers and managing talent also presented significant positive impacts in 2017, with 0.11 SDs and 0.05 SDs, respectively. Those results reinforce the idea that recognizing and encouraging high performance is an effective strategy for improving student outcomes (HWA; LEAVER, 2021). Also, support the importance of attracting and retaining qualified teachers (BLOOM *et al.*, 2015).

Moreover, attracting talent/creating a distinctive employee value proposition had a negative and significant impact between 2013 and 2015. However, in 2017, it had a significant positive impact, 0.09 SDs, suggesting that creating an attractive work environment for teachers can help to improve student performance (DARLING-HAMMOND *et al.*, 2005; CARRELL; WEST, 2010; INGERSOLL *et al.*, 2014; KRAFT; PAPAY, 2014; FINAN *et al.*, 2017). Standardizing Instructional Processes changes over the years, reflecting the importance of having well-defined and consistent teaching processes (GLEWWE; MURALIDHARAN, 2016; MURALIDHARAN *et al.*, 2019).

Table 10 – Mechanism using 9th grade results

	Mathematics					Language				
	07/09	07/11	07/13	07/15	07/17	07/09	07/11	07/13	07/15	07/17
Personalizing of Instruction and Learning	0.012	-0.004	-0.006	-0.059***	0.108***	0.013	0.010	-0.032	-0.085***	0.062**
	(0.020)	(0.021)	(0.023)	(0.022)	(0.024)	(0.021)	(0.022)	(0.024)	(0.024)	(0.024)
Performance Review	-0.117***	-0.056***	-0.067***	-0.110***	-0.145***	-0.104***	-0.043**	-0.066***	-0.107***	-0.163***
	(0.019)	(0.020)	(0.021)	(0.020)	(0.021)	(0.020)	(0.020)	(0.021)	(0.021)	(0.021)
Managing Talent	0.016	0.043	0.085***	-0.019	0.061*	-0.047*	0.055*	0.117***	-0.100***	0.051*
	(0.027)	(0.029)	(0.031)	(0.030)	(0.032)	(0.029)	(0.029)	(0.032)	(0.032)	(0.024)
Promoting High Performers	-0.020	-0.098***	-0.005	0.063***	0.145***	0.004	-0.066***	-0.013	0.013	0.118***
	(0.020)	(0.021)	(0.021)	(0.022)	(0.023)	(0.021)	(0.021)	(0.022)	(0.023)	(0.024)
Attracting Talent/Creating a Distinctive Employee Value Proposition	-0.005	-0.030	-0.045**	-0.026	0.081***	-0.003	-0.008	-0.078***	-0.056***	0.097***
	(0.020)	(0.021)	(0.021)	(0.020)	(0.022)	(0.021)	(0.021)	(0.021)	(0.022)	(0.023)
Standardization of Instructional Processes	0.002	-0.105***	-0.050**	0.133***	-0.024	0.020	-0.080***	-0.086***	0.051*	-0.004
	(0.024)	(0.025)	(0.025)	(0.025)	(0.026)	(0.026)	(0.025)	(0.026)	(0.027)	(0.026)
Adopting Educational Best Practices	-0.039**	-0.009	0.028	0.059***	0.036	-0.023	0.027	-0.024	0.051**	0.019
	(0.020)	(0.021)	(0.021)	(0.021)	(0.022)	(0.021)	(0.021)	(0.022)	(0.022)	(0.022)
Controls	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Year + Municipality F.E	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Municipality Cluster	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

Notes: *** denotes significance at 1 percent, ** at 5 percent, and * at 10 percent level. This table shows the impacts of each component of the management index test scores for 9th grade. Test scores are from *Prova Brasil/SAEB*, the national standardized exam undertaken every two years. The school controls are white student, race not declared student, female student, student age, student per class, special needs facilities, computer lab, science lab, special education classroom, sports court, library, internet access, female teacher percentage, white teacher percentage, race not declared teacher percentage, postgraduate teacher percentage, classes per teacher. By choice, the authors decided to omit the covariate results. Municipality-specific and time trends fixed-effects are included. Standard errors are clustered by municipality.

The analysis of tables 9 and 10 denotes the role of effective school management practices in educational outcomes. In 5th and 9th grades, topics such as management talent and standardization of instructional process emerged as critical drives of student success in mathematics and language. Bloom *et al.* (2015), Glewwe e Muralidharan (2016), Fryer *et al.* (2017), Leaver *et al.* (2019), highlight how strategic efforts to recruit, retain and develop high-quality teachers can significantly improve student performance.

However, the analysis also reveals the complexities of implementing management practices effectively. Attracting Talent and Creating a Distinctive Employee Value Proposition showed notable positive impacts in language and

mathematics, especially in 5th grade, relating the results with the importance of a supportive work environment (INGERSOLL *et al.*, 2014). The negative outcomes associated with performance review suggest that managing this practice needs to be careful, or it can detract from student outcomes. This topic evidences the need for management practices that are strategically designed and sensitively implemented to encourage a positive and productive educational environment, (HWA; LEAVER, 2021). These findings reinforce the idea that while effective management is essential, its success depends heavily on the context and implementation in which it is applied.

Analyzing retention and abandonment outcomes in primary education highlights the critical role of effective school management practices in mitigating inefficiencies within the education system. From 2011 to 2017, the results show that personalized learning approaches, adopting best practices, and standardizing instructional processes significantly reduced retention and abandonment rates. For instance, personalization of instruction exhibited consistent positive effects, with reductions in retention and abandonment becoming increasingly significant over time. These findings align with the broader literature emphasizing the need for tailored educational strategies to address student needs (BARROS *et al.*, 2021; ALVES *et al.*, 2017).

Conversely, performance reviews showed limited or mixed effects, suggesting implementation challenges. While intended to enhance accountability, poorly executed performance reviews may have demotivated educators, reducing their effectiveness. These findings indicate that management interventions must be carefully designed and contextually adapted to achieve their intended outcomes without unintended consequences.

Table 11 – Mechanism using primary education results - Retention and Abandonment

	Retention					Abandonment				
	07/09	07/11	07/13	07/15	07/17	07/09	07/11	07/13	07/15	07/17
Personalizing of	-0.013	-0.057***	-0.022**	-0.025**	-0.048***	-0.008	-0.007	-0.022***	-0.035***	-0.023***
Instruction and Learning	(0.010)	(0.010)	(0.011)	(0.010)	(0.010)	(0.006)	(0.008)	(0.007)	(0.007)	(0.006)
Performance	-0.015	-0.064***	-0.031***	-0.041***	-0.047***	-0.001	0.001	0.005	0.006	0.003
Review	(0.010)	(0.010)	(0.011)	(0.010)	(0.010)	(0.006)	(0.008)	(0.007)	(0.007)	(0.006)
Managing	-0.005	0.046***	-0.003	0.001	0.008	-0.013*	-0.014	-0.015*	-0.004	-0.009
Talent	(0.012)	(0.011)	(0.012)	(0.012)	(0.012)	(0.007)	(0.009)	(0.008)	(0.007)	(0.007)
Promoting	-0.009	0.004	-0.026**	-0.022**	0.002	0.010	0.001	0.003	0.002	0.001
High	(0.011)	(0.010)	(0.011)	(0.011)	(0.011)	(0.007)	(0.009)	(0.007)	(0.007)	(0.007)
Performers										
Attracting Talent/Creating	0.011	-0.012	-0.007	-0.020**	-0.012	-0.007	0.006	0.001	-0.010	-0.007
a Distinctive Employee	(0.010)	(0.010)	(0.011)	(0.010)	(0.010)	(0.006)	(0.008)	(0.007)	(0.006)	(0.006)
Value Proposition										
Standardization of	0.006	-0.007	-0.043***	-0.038***	-0.033***	-0.003	0.001	0.002	-0.012*	-0.014**
Instructional Processes	(0.010)	(0.010)	(0.011)	(0.010)	(0.010)	(0.006)	(0.008)	(0.007)	(0.006)	(0.006)
Adopting Educational Best	0.008	0.008	-0.026**	-0.029***	-0.019*	0.000	0.009	-0.002	-0.016**	-0.015**
Practices	(0.010)	(0.010)	(0.011)	(0.010)	(0.010)	(0.006)	(0.008)	(0.007)	(0.006)	(0.006)
Controls	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Year + Municipality F.E	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Municipality Cluster	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

Notes: *** denotes significance at 1 percent, ** at 5 percent, and * at 10 percent level. This table shows the impacts of good management practices on retention and abandonment for 5th and 9th grades in Ceará and border states after the TA and RBF reform. Failure in school and dropout are questions for students from *Prova Brasil/SAEB*, the national standardized exam undertaken every two years. The municipality controls are white student, race not declared student, female student, student age, student per class, special needs facilities, computer lab, science lab, special education classroom, sports court, library, internet access, female teacher percentage, white teacher percentage, race not declared teacher percentage, postgraduate teacher percentage, classes per teacher. By choice, the authors decided to omit the covariate results. School retention refers to requiring a student to repeat a grade level due to insufficient academic progress. School abandonment occurs when, at the end of the school year, a student stops attending classes (without being transferred) but returns to school the following year. Municipality-specific and time trends fixed-effects are included. Standard errors are clustered by municipality.

In contrast to primary education, results from lower secondary education (9th grade) reveal limited impacts of management practices on retention and abandonment. Notably, personalization of instruction and talent management displayed sporadic effects, with some years showing significant improvements and others reflecting negligible impacts. These findings may be attributed to the greater complexity of addressing retention and abandonment at this stage, where socioeconomic disparities and accumulated learning gaps become more pronounced,

as noted by Cury (2008) and Vieira *et al.* (2019).

Table 12 – Mechanism using lower secondary results - Retention and Abandonment

	Retention					Abandonment				
	07/09	07/11	07/13	07/15	07/17	07/09	07/11	07/13	07/15	07/17
Personalizing of	0.009	-0.010	-0.031**	0.016	-0.054***	0.005	0.002	0.017**	0.002	0.014
Instruction and Learning	(0.014)	(0.011)	(0.015)	(0.015)	(0.015)	(0.008)	(0.010)	(0.009)	(0.009)	(0.008)
Performance	0.051***	-0.008	0.029**	0.008	-0.027**	0.013*	-0.007	0.007	-0.002	-0.010
Review	(0.013)	(0.011)	(0.014)	(0.013)	(0.013)	(0.008)	(0.010)	(0.008)	(0.008)	(0.007)
Managing	-0.055***	-0.029*	-0.060***	0.001	-0.050**	0.003	-0.004	0.001	0.021*	-0.008
Talent	(0.019)	(0.016)	(0.020)	(0.021)	(0.020)	(0.011)	(0.014)	(0.012)	(0.012)	(0.012)
Promoting	-0.015	-0.011	-0.008	-0.033**	-0.044***	-0.004	-0.001	0.003	-0.016**	-0.012
High	(0.014)	(0.011)	(0.014)	(0.015)	(0.015)	(0.008)	(0.010)	(0.008)	(0.008)	(0.008)
Performers										
Attracting Talent/Creating	0.014	-0.001	0.032**	0.019	0.052***	0.002	-0.011	0.014*	0.005	0.005
a Distinctive Employee	(0.014)	(0.011)	(0.014)	(0.014)	(0.014)	(0.008)	(0.010)	(0.008)	(0.008)	(0.008)
Value Proposition										
Standardization of	-0.061***	-0.049***	-0.046***	-0.043**	-0.053***	-0.008	-0.023*	-0.005	-0.020**	-0.012
Instructional Processes	(0.017)	(0.013)	(0.017)	(0.017)	(0.016)	(0.010)	(0.012)	(0.010)	(0.009)	(0.009)
Adopting Educational Best	0.013	-0.004	0.001	0.002	0.000	0.023***	-0.007	0.016**	-0.005	-0.001
Practices	(0.014)	(0.011)	(0.014)	(0.014)	(0.014)	(0.008)	(0.010)	(0.008)	(0.008)	(0.008)
Controls	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Year + Municipality F.E	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Municipality Cluster	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

Notes: *** denotes significance at 1 percent, ** at 5 percent, and * at 10 percent level. This table shows the impacts of good management practices on retention and abandonment for 5th and 9th grades in Ceará and border states after the TA and RBF reform. Failure in school and dropout are questions for students from *Prova Brasil/SAEB*, the national standardized exam undertaken every two years. The municipality controls are white student, race not declared student, female student, student age, student per class, special needs facilities, computer lab, science lab, special education classroom, sports court, library, internet access, female teacher percentage, white teacher percentage, race not declared teacher percentage, postgraduate teacher percentage, classes per teacher. By choice, the authors decided to omit the covariate results. School retention refers to requiring a student to repeat a grade level due to insufficient academic progress. School abandonment occurs when, at the end of the school year, a student stops attending classes (without being transferred) but returns to school the following year. Municipality-specific and time trends fixed-effects are included. Standard errors are clustered by municipality.

Interestingly, some mechanisms, such as talent attraction and the standardization of instructional processes, began to show positive impacts in the later years of analysis (2015–2017). This shift indicates that sustained investments in these areas could yield long-term benefits, even in more challenging educational environments. However, the lack of consistent positive outcomes highlights the necessity for additional support measures tailored to secondary education, such

as targeted interventions for at-risk students and comprehensive teacher training programs.

The mechanisms driving the success of the TA and RBF reforms are closely tied to the quality of school management, as reflected in the SMQI framework. Schools with high management quality leveraged the reforms more effectively by implementing structured processes, fostering accountability, and aligning resources with targeted goals. For instance, the adoption of systematic performance reviews helped these schools identify areas for improvement and allocate resources more strategically, a practice aligned with the findings of Alves *et al.* (2017), who emphasized the importance of managerial oversight in driving educational outcomes. These mechanisms were particularly effective in primary education, where the challenges were less pronounced, allowing management practices to yield more immediate results.

However, specific mechanisms, such as performance reviews and teacher feedback, revealed implementation challenges in schools with lower management quality. These schools could not often effectively interpret and act on performance data, leading to inconsistent outcomes. As highlighted by Barros *et al.* (2021), the success of such mechanisms is contingent on the institutional capacity to operationalize reforms, suggesting the need for complementary interventions, such as leadership training and capacity-building programs, to ensure consistent implementation across all schools. However, as noted by Cury (2008), the effectiveness of financial incentives depends heavily on the equitable distribution of resources and the ability of schools to sustain improvements without reliance on external rewards.

Together, these mechanisms highlight the critical role of school management in operationalizing reforms. While the TA and RBF provided a robust framework for improvement, the degree of success was ultimately mediated by the capacity of individual schools to adapt and implement these practices. This

underscores the importance of strengthening institutional capacity alongside reform implementation to ensure sustained and equitable improvements in educational outcomes.

To understand the reductions in retention and abandonment rates in primary education, it is crucial to consider the specific mechanisms employed by schools with high SMQI scores. These schools utilized early intervention programs such as remedial classes and personalized learning plans to address academic deficiencies before they became insurmountable. Robust monitoring systems also allowed for the early identification of at-risk students, enabling timely resource allocation. The combination of structured instructional processes and targeted teacher support played a pivotal role in achieving these outcomes. However, the limited impact observed in secondary education suggests that these mechanisms were less effective or insufficiently scaled, highlighting the need for tailored interventions to address the unique challenges of older students, such as wider learning gaps and socioeconomic disparities.

3.6 Economic Implications of Schools with Effective Management Practices

The educational reforms in Ceará represent a transformative approach to addressing longstanding challenges in public education. However, these reforms come with significant economic costs that must be carefully evaluated to ensure their sustainability and effectiveness. The state has allocated substantial resources to improve educational outcomes, from investments in teacher training, school bonification, and infrastructure to implementing innovative programs like TA and RBF.

These costs are not merely financial; they also involve opportunity costs, as funds directed toward education could have been allocated to other critical areas such as healthcare or infrastructure. Despite these expenditures, the long-term

economic benefits of improved education—such as higher labor market productivity, reduced inequality, and broader social mobility—highlight the importance of these investments. In the context of Ceará's reforms, understanding the balance between these economic costs and the potential developmental returns is essential for designing equitable and impactful policies.

Since most of these economic costs are incurred at the municipal level, and our focus is on the school level, specifically on schools that demonstrated good management practices before implementing educational reforms in Ceará, we concentrate on two main economic costs. The first relates to PEN10, which provides financial bonuses to the top 150 schools whose students achieve high scores in Ceará's Basic Education Evaluation System tests. The second cost pertains to students repeating a grade due to insufficient academic progress or abandonment. For this analysis, we treat the costs of retention and abandonment as equivalent since, in both cases, the student is required to repeat the original grade, incurring similar financial expenditures.

The School of Excellence Award demonstrated some positive effects on school outcomes, as noted by Koslinski *et al.* (2017), Carneiro e Irffi (2023). However, the award was never formally linked to the financial transfers received by schools based on the quality of their management practices. Using administrative data from the State Department of Education of Ceará, we identified that 990 schools received this bonus across various grade levels between 2009 and 2017 in recognition of their high performance. For our analysis, we included all schools in our dataset regardless of their grade configuration. We then matched 195 schools from our database previously categorized as high- or low-performing in school management practices. This matching exercise enables us to assess whether effective management practices were associated with schools recognized for excellence and better understand the relationship between recognition, management, and school

outcomes.

We used our high enforcement variable to classify schools in Ceará into those with good or poor management practices. The analysis revealed that 76 schools classified as having poor management practices received bonuses between 2009 and 2017, with an average amount of $R\$300,866.60$ over this period. In contrast, 117 schools with good management practices received bonuses averaging $R\$428,890.70$ between 2009 and 2017. This represents an average difference of $R\$128,024.10$, indicating that schools with good management practices received substantially more in financial bonuses than those classified as poor in management practices.

When considering the global bonus distribution from 2009 to 2017, schools below the median of the SQMI in Ceará received a total of $R\$22,865,864$. Meanwhile, schools above the median of the SQMI received $R\$50,180,217$, resulting in a difference of $R\$27,314,353$. This substantial disparity underscores the significant financial advantage enjoyed by schools with good management practices, reflecting the effectiveness of targeted incentive structures in encouraging high performance within Ceará's educational reforms[18].

Several authors have highlighted the negative impact of student retention and school abandonment on both educational outcomes and public expenditures (EIDE; SHOWALTER, 2001; JACOB; LEFGREN, 2009; GOMES-NETO; HANUSHEK, 1994; MENEZES-FILHO *et al.*, 2008; HANUSHEK, 1995; LEON; MENEZES-FILHO, 2002; VALBUENA *et al.*, 2021; BARROS *et al.*, 2021). In line with this literature, we calculate the annual cost of basic education per student in Ceará. To estimate this, we aggregate the total municipal education expenditures in Ceará and divide them by the number of students enrolled in municipal schools. Additionally, we compute the total number of students retained or dropped out

[18] Monetary values in Reais (Brazilian currency) deflated to 2023 using the IPCA

in primary and lower secondary education across the state. These calculations allow us to estimate the financial burden associated with inefficiencies in student progression. The results are presented in Table 13.

Table 13 – Spent per student, School Retention and School Abandonment in municipal schools in Ceará

Year	Spent per Student in municipal basic education	Retention in primary years	Abandonment in primary years	Retention in lower secundary years	Abandonment in lower secundary years
2007	$3,092.76	97,443	24,172	61,838	39,262
2009	$4,116.21	70,561	16,767	54,897	28,946
2011	$5,556.82	46,303	9,959	46,635	20,290
2013	$5,822.36	26,006	5,862	39,313	15,655
2015	$6,322.91	20,820	3,307	33,339	12,400
2017	$6,463.71	15,451	2,494	26,114	9,158

Source: National Treasury Secretariat / Schoolar Census. **Notes:** Monetary values in Reais (Brazilian currency) deflated to 2023 using the IPCA. Total of students in municipal schools in Ceará with retention and abandonment in primary and lower secondary grades. School retention refers to requiring a student to repeat a grade level due to insufficient academic progress. School abandonment occurs when, at the end of the school year, a student stops attending classes (without being transferred) but returns to school the following year.

Building on the findings presented in Section 3.4.3, we focus exclusively on the significant results for retention and abandonment within primary school years. Specifically, we examine retention data from 2011 to 2017 and abandonment data from 2015 to 2017, limiting our analysis to periods where the results were statistically significant. Since the outcomes are expressed in percentages, we use these figures to estimate the number of students who successfully progressed in their education, avoiding grade repetition due to insufficient academic progress or school abandonment. This method provides a clearer understanding of the factors contributing to improved student progression over these years.

Between 2011 and 2017, we estimate that 4,416 students avoided grade repetition due to improved academic progress or reduced school abandonment, based on the aggregation of significant results related to retention and abandonment. This improvement resulted in a financial saving of $R\$25,992,769.28$[19] in municipal

[19] Monetary values in Reais (Brazilian currency) deflated to 2023 using the IPCA

costs for schools and municipalities with good management practices compared to other schools. These results highlight effective school management practices' economic and educational benefits, demonstrating their role in reducing unnecessary expenditures and enhancing student outcomes.

The estimated savings of $R\$25,992,769.28$ achieved through reductions in grade repetition and school abandonment underscore the financial efficiency of the TA and RBF reforms in Ceará. These savings highlight the potential of effective school management practices to alleviate fiscal pressures on municipalities while improving educational outcomes. However, these financial gains also represent an opportunity to reinvest in critical areas of the education system. For example, municipalities could allocate these resources to continuous teacher training programs essential for maintaining and enhancing instructional quality. Expanding infrastructure, such as building additional classrooms or upgrading technology, could address systemic challenges and support student learning, particularly in underserved areas. Additionally, targeted programs for at-risk students could be developed to prevent dropouts and ensure equitable access to education.

While the redistribution of ICMS revenue incentivized performance improvements across municipalities, examining whether this mechanism inadvertently widened disparities between wealthier and poorer regions is essential. Municipalities with higher baseline management quality or greater resources may have been better positioned to leverage these incentives, potentially exacerbating existing inequalities.

Conducting a complementary analysis of fiscal dynamics would provide valuable insights into the equity of resource allocation under the current policy framework. Such an analysis could explore whether the ICMS redistribution disproportionately benefited municipalities that were already advantaged or if it effectively supported those most in need.

The long-term economic implications of these savings warrant careful consideration. By addressing inefficiencies in the education system, municipalities can reallocate financial resources toward other critical public services, such as healthcare and social welfare, thereby generating broader societal benefits. However, sustaining these improvements requires a strategic balance between meeting immediate fiscal demands and making targeted investments in the education sector. Such investments are essential to ensure that the observed gains are preserved and amplified over time. These findings underscore the need for a comprehensive approach to policy design that prioritizes economic efficiency and equity to maximize the transformative impact of educational reforms.

These findings highlight two critical advantages of good school management practices. First, they reduce inefficiencies in the education system, such as grade repetition and school abandonment, which are associated with significant financial and educational costs. Schools save resources and enhance the overall learning experience by improving student progression rates. Second, these practices incentivize excellence through targeted financial bonuses, such as those provided by the PEN10, which reward high-performing schools. Together, these strategies create a positive feedback loop where improved management leads to better student outcomes and more efficient use of public funds. This approach demonstrates a sustainable model for broader educational reforms, showing that aligning economic incentives with educational goals can yield long-term benefits for students and municipalities.

While the ICMS redistribution and PEN10 awards incentivized performance improvements, their design may have unintentionally widened disparities between municipalities with varying baseline capacities. Wealthier municipalities or those with pre-existing high management quality were likely better positioned to leverage these incentives, potentially leaving underperforming schools further

behind. Future policies should incorporate equity-focused adjustments, such as providing additional resources to low-performing municipalities, to ensure that all schools can benefit from these reforms.

3.7 Concluding Remarks

This chapter provides new insights into the role of school management quality in amplifying the effectiveness of educational reforms, focusing on the TA and RBF programs implemented in Ceará, Brazil. By integrating the SMQI into the analysis, this research highlights how schools with strong management practices prior to the reforms achieved superior outcomes in both educational performance and fiscal efficiency, distinguishing itself from previous studies that largely examine aggregate effects of reforms (LAUTHARTE *et al.*, 2021; LOUREIRO *et al.*, 2020).

In terms of proficiency, the study corroborates previous findings by showing that 5th-grade students in well-managed schools outperformed their counterparts, with effect sizes of 0.1 SDs in mathematics and 0.09 SDs in language. However, the reforms were less effective for 9th-grade students, where no significant improvements in retention or abandonment rates were observed. This divergence underscores the systemic challenges faced in secondary education, including accumulated learning gaps and heightened socioeconomic disparities, as emphasized by Cury (2008) and Vieira *et al.* (2019). These results are consistent with those already found in the literature (SHIRASU *et al.*, 2013a; PETTERINI; IRFFI, 2013; BRANDÃO, 2014a; CARNEIRO; IRFFI, 2018; SILVA, 2021; IRFFI *et al.*, 2021; LAUTHARTE *et al.*, 2021; CARNEIRO *et al.*, 2022), but they add a new context, which is school management.

The findings also demonstrate that schools with higher management quality significantly reduced grade retention and abandonment rates, particularly in primary education. Between 2011 and 2017, schools with good management

practices achieved savings of approximately $R\$25,992,769.28$ in municipal costs by mitigating these inefficiencies. Retention rates showed significant improvements starting in 2009, while abandonment rates began to decline meaningfully from 2013 onward. In addition to these gains, schools above the SMQI median received $R\$27,314,353$ more in financial bonuses from the *Prêmio Escola Nota Dez* (PEN10) compared to those below the median. These economic impacts highlight the dual benefits of effective school management: improving student outcomes while reducing fiscal pressures on municipalities.

We also investigated potential mechanisms for this finding. Using the SQMI topics, we divided each subject into a possible channel for our conclusions. The results show the effective school management practices in educational outcomes. In 5th and 9th grades, topics such as management talent and standardization of instructional process emerged as critical drives of student success in mathematics and language. However, the analysis also reveals the complexities of implementing management practices effectively. The adverse outcomes associated with performance reviews suggest that careful management of this practice is crucial, as it can otherwise negatively impact student outcomes. This issue emphasizes the need to strategically design and thoughtfully implement management practices to foster a positive and productive educational environment. These findings reinforce the idea that effective management is essential, but its success heavily depends on how and where it is applied.

Although our identification strategy and robustness checks strongly suggest that good management practice increases the effect of educational reforms, we need to be careful in extrapolating possible test score gains in different contexts. (GLEWWE; MURALIDHARAN, 2016). The reforms implemented by Ceará, as well as the political and technical context, were essential in enabling this educational transformation (LOUREIRO *et al.*, 2020).

The main contribution of this chapter lies in its nuanced exploration of how pre-existing management quality mediates the success of educational reforms. Unlike earlier research, this paper bridges the gap between performance incentives and the operational realities of schools, providing evidence that financial and managerial structures must be aligned to maximize reform impacts. Moreover, by quantifying the economic savings and linking them to specific educational outcomes, this study advances the discourse on the cost-effectiveness of targeted interventions in public education.

This chapter contributes to two strands of the literature. First, it adds to the body of research on educational reform in Brazil, focusing on the case of Ceará. Second, it contributes to the growing literature on the role of school management quality in shaping educational outcomes. Our findings also raise important questions for future research. Notably, they open promising avenues for further investigation into the effects of effective management practices across different educational settings in Brazil, using the School Quality Management Index (SQMI) developed by Leaver *et al.* (2019). A particularly relevant direction would be to explore whether strong management practices have a measurable impact on municipal education systems and whether there are spillover effects in municipalities located near administrative borders.

This research also highlights the limitations of TA and RBF reforms in addressing challenges in secondary education, suggesting the need for complementary strategies that target systemic barriers. Future policies should focus on integrating management reforms with tailored interventions for underperforming schools and disadvantaged communities, ensuring equitable outcomes across educational levels. Additionally, further research could explore the scalability of these management practices and their applicability in diverse educational and socioeconomic contexts, contributing to a broader understanding of how to design effective and sustainable

education reforms.

4 PERFORMANCE-BASED FISCAL TRANSFERS AND EDUCATIONAL INEQUALITY

4.1 Introduction

Financing represents a fundamental pillar in the provision of public education. Recent empirical evidence shows that the amount of resources allocated to education significantly influences educational outcomes (JACKSON *et al.*, 2016; JACKSON *et al.*, 2021; HADDAD *et al.*, 2017). In developing countries, where fiscal constraints frequently limit educational investment, the importance of adequate funding becomes even more pronounced. In the case of Brazil, the relationship between public spending and educational outcomes displays substantial heterogeneity. This variation suggests that the quantity, structure, and incentives embedded in educational expenditures can influence results (BARROS *et al.*, 2018). Consequently, when incentive schemes are diffuse or poorly aligned with performance goals, they may hinder the delivery of quality public education and reduce the overall effectiveness of education spending.

Recent policies consist of distributing public resources based on the performance or merit of those responsible for education (stakeholders). This policy aims to solve the agency's problem by inducing the stakeholders to obtain better educational results (CARNEIRO; IRFFI, 2018). Different schemes have already been applied and tested [1] around the world, and their results are promising. The standard approaches redistribute resources at the school level (FIGLIO; ROUSE, 2006), the professor level (REBACK, 2008; FERNANDES; FERRAZ, 2014; MBITI *et al.*, 2019a), or the parental level (FIGLIO; LUCAS, 2004). The main advantage of adopting this type of policy is creating incentives to improve education. On the other hand, critics argue that such incentives can replace the intrinsic motivation

[1] For a recent review of this literature, see Lee e Medina (2019).

of education and increase inequality between entities or individuals (FIGLIO; GETZLER, 2006; CULLEN; REBACK, 2006; NEAL; SCHANZENBACH, 2010).

An innovation introduced by the state of Ceará in 2009 was the redistribution of tax transfers based on the aggregate educational performance of the municipalities. Unlike other strategies that focus on school, teacher, or student levels, the legislation 14.023 of 2007 (henceforth *Quota-Parte* program (QLP)) defined criteria for distributing resources from the ICMS tax quota according to the educational performance of the municipalities in Elementary Education. Considering all schools in such a municipality, this performance is measured, implying a greater incentive for mayors to increase the local educational levels. One-quarter (25%) of resources received by the state tax with ICMS are distributed to municipalities, and 18% of these resources are distributed according to municipal educational performance. The remaining 7% are distributed according to the quality of health and the municipal environment.

Initial empirical evidence points out that such a policy increased student performance [2]. Figure C1.1, available in the Appendix, summarizes part of this evidence. The average performance of the municipalities in IDEB (Basic Education Development Index) presented a significant increase in the 5th grades of Elementary Education of Ceará's students, even though the state has a similar adverse socioeconomic situation to neighboring states.

The *Quota-Parte* program has two exciting features. First, the resources distributed are fungible; the mayors who receive the resources are not obliged to spend them on education. This implies that there is no guarantee that the resources

[2] Examples of this literature are: Brandão (2014b), Carneiro e Irffi (2017), Petterini e Irffi (2013), Shirasu *et al.* (2013b). A limitation of part of this literature stems from the absence of controls for policies implemented simultaneously as the *Quota-Parte* program. In the case of Ceará, an important program that can confuse the results is the Literacy Program at the Right Age (PAIC). Recent evidence (MURALIDHARAN *et al.*, 2019) shows that the combination of performance spending policies and incentives for their proper implementation can explain most of the results.

will be allocated to education. Second, the performance of students is measured at the aggregate municipal level. This last characteristic incentive is for the municipal government to raise the average performance of students, even if inequality among schools also increases.

This chapter aims to analyze these two aspects. First, we investigate whether municipalities that received more resources with the *Quota-Parte* program in 2009 increased the spending on education. Although the resources are not fungible, it is interesting to understand the composition effect of the transfers on municipal spending. Second, we examine whether previous school performance, before the *QLP* program, matters for educational school performance in municipalities that benefited from the program compared to municipalities that lost resources with the policy introduction.

We report two main findings. First, municipalities that benefited from the *Quota-Parte* program did not increase the spending on education. However, we observe an expansion in the total non-educational expenditure. Specifically, for each real received by the municipalities from the program, $R\$\,0,45$ was spent on education ($R\$\,0,23$ in Elementary Education) and $R\$\,1,96$ on total expenses per capita.

Second, by exploring inter-municipal heterogeneity in school performance before the *Quota-Parte* program, we find that schools with low performance in 2007 did not increase their educational results in municipalities that have benefited from this program. The estimates suggest that the *Quota-Parte* program had a relevant impact in schools with higher performance before the program's introduction. The direct implication is that such a policy increases educational inequality within the schools.

In addition, we extend our findings to verify whether there was evidence of different allocation of resources within the schools. We test if municipalities that

received more resources from *QLP* impacted other school outcomes associated with the quality of public education provision and higher education spending. The results suggest that schools with prior higher performance in municipalities benefiting from *QLP* significantly reduced the average class size. This same result was not found for schools with lower previous performances in municipalities also benefiting from *QLP*. There was no significant difference concerning the average number of hours per day, although the magnitude of the estimates supports the validity of the hypothesis of different allocations between schools.

Taken together, the intergovernmental transfer policy based on the educational performance of municipalities did not raise the expenditure on education. It increased the educational inequality at the school level[3]. These differences within the schools may be driven by a specific allocation of resources in schools with higher previous performance. In 2011, the program was reformulated (Legislation 30.796) to provide incentives to municipalities that improve the grades of low-achievers students (LAUTHARTE *et al.*, 2021). This reformulation suggests that Ceará's government may have perceived that the previous rule incentivized selective spending by the majors.

This study contributes to some areas of the economics of education. First, for a broad literature on the importance of public spending for the quality of education (HANUSHEK, 2005; MANUELLI; SESHADRI, 2014; HADDAD *et al.*, 2017; JACKSON *et al.*, 2016; JACKSON *et al.*, 2021). Second, to provide adequate incentives, many policies are designed to reward performance. Recent research has been carried out on this topic, and this article contributes by analyzing how incentives to specific stakeholders potentially generate differentiated resource allocations: (PLECKI *et al.*, 2006; BEUERMANN *et al.*, 2018; HADDAD *et al.*, 2017; MBITI *et al.*, 2019a; MBITI *et al.*, 2019b; ROMERO *et al.*, 2020; KERWIN;

[3] The *Quota-Parte* program was reformulated in 2011 to adapt the incentives to reduce inequality performance among the schools.

THORNTON, 2021). Finally, financing public education is a challenge in developing countries like Brazil. Thus, this study contributes to a broad literature that attempts to understand which mechanisms should be used to increase education spending. Specifically, we focus on the impact of intergovernmental transfer programs, similar to Brandão (2014b), Carneiro e Irffi (2017), Petterini e Irffi (2013), Shirasu *et al.* (2013b), Lautharte *et al.* (2021), Silva (2021). This last point is essential given the approval of the new FUNDEB (Basic Education Maintenance and Development Fund), which was partly inspired by the Ceará program. Our study contributes to the literature by highlighting the backfires of similar results-based transfers.

In addition to this introduction, this chapter is subdivided into six more sections. The following section details the *Quota-Parte* program. Section 3.3 discusses the database used in this work and the empirical strategies adopted. Section 3.4 reports and discusses the results of the impact of QLP on Municipal Public Spending. Section 3.5 reports the results of the Effect of QLP on Educational Outcomes. Section 3.6 discusses the Mechanisms of allocation of resources. Finally, section 3.7 comments on the general conclusions of the work.

4.2 Transfer Results-Based Policy

The state of Ceará has successfully overcome adverse socioeconomic conditions to improve educational outcomes significantly. It implemented a comprehensive educational reform that enhanced literacy learning among elementary school students by introducing Results-Based Financing (RBF) policies as a central component of a broader reform agenda (LOUREIRO *et al.*, 2020).

The Ceará's effectiveness is based on three interdependent policies, which can be mentioned as follows: 1. Financial incentives for the municipalities to reach the established educational goals (*Quota-Parte* program); 2. Technical assistance to municipalities with difficulties in improving learning, emphasizing literacy at the

right age for students (PAIC); 3. A reliable monitoring and evaluation system that continuously measures the main results of education, including student learning (SPAECE)[4].

The ICMS (Tax on the Circulation of Goods and Services) is a state-level tax in Brazil. The Federal Constitution mandates that 25% of its revenue be redistributed among municipalities through an intergovernmental transfer known as the Quota-Parte. Each state has discretion over how to allocate these resources among its municipalities. Ceará pioneered a novel approach by using this fiscal discretion to incentivize municipalities to improve social outcomes—particularly in education. This initiative marked one of the first efforts in Brazil to link intergovernmental transfers to educational performance. In 2020, discussions surrounding the creation of the New FUNDEB brought greater national attention to the use of education-focused transfers. That same year, Constitutional Amendment No. 108/2020 was enacted, establishing the new FUNDEB and requiring all states to revise their ICMS distribution rules to adopt an ICMS-Education model. This model, inspired by Ceará's experience initiated in 2007, became the national reference for aligning fiscal transfers with educational outcomes (Todos Pela Educação, 2023). Figure C1.2 illustrates the percentage of ICMS revenues linked to educational performance across Brazilian states following the approval of the new FUNDEB.

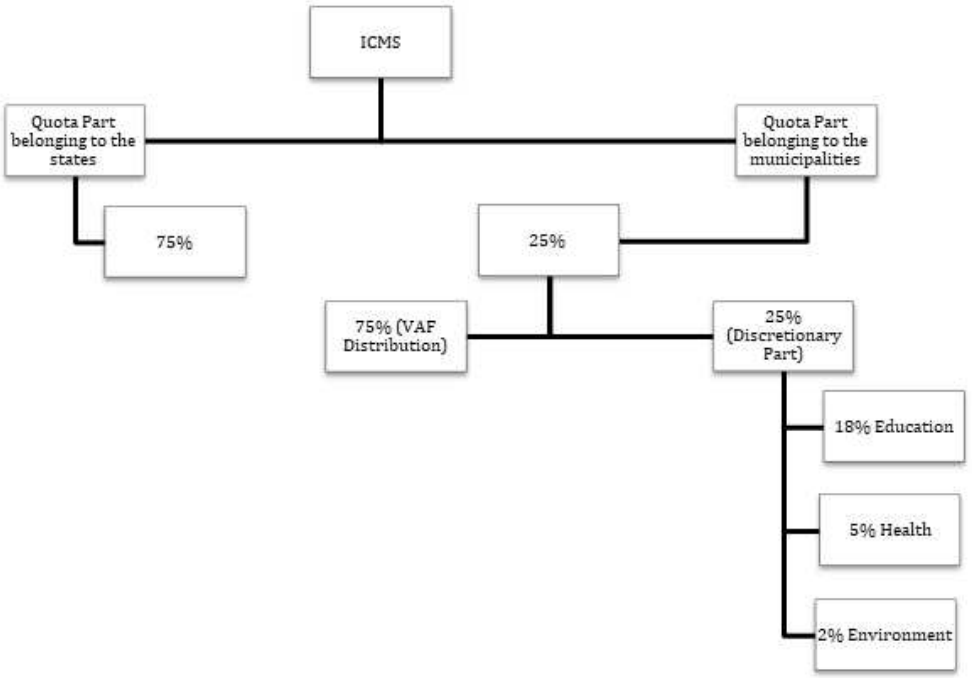
The main focus of Ceará's program is education. The program started from legislation 14,023 in 2007, was regulated in 2008, and became effective in 2009. From the 25% of the total state ICMS's revenue, 72% is destined based on municipal educational results, 20% for health outcomes, and 8% for environmental performance. That intergovernmental transfer program replaced the previous criterion based on the size of the municipality, stated since 1996[5]. Figure B2.2

[4] Permanent Evaluation System for Basic Education in Ceará

[5] Legislation nº. 12,612 of 1996, established that the distribution of the ICMS share of the municipalities should comply with the following criteria: 75% by the tax added value; 12.5%

outlines the new distribution of ICMS for Ceará municipalities. The transfer is based on municipal performance in the educational quality indexes that consider the level and improvements in literacy of 2nd-grade students, the performance of 5th-grade students in reading and mathematics, and the average approval rates from 1st to 5th grade [6].

Figure 14 – ICMS transfer structure



The criteria for sharing 25% of ICMS not linked to added value were established by state legislation 14,023 of December 17, 2007, [7] calculates the

relative to the proportion of spending on education over municipal revenue; 7.5% equitable to all municipalities; and 5% proportional to the population of each municipality.

[6] For a review of the implementation of this policy, Simões e Araújo (2019), Brandão (2014b). For a detailed description of the program rules, see: Júnior *et al.* (2020).

[7] Since 2012, when the computation of the formation of the educational index (IQE) was changed by Decree nº. 30,796 of 2011, the transfer of 18% of the ICMS share to the municipalities was linked to the weighted sum of the following components: (i) 50% of the resources are distributed according to the literacy quality index (IQA), calculated from the results in the literacy exam of students in the 2nd year of elementary school; (ii) 45% according to the elementary school quality index (IQF), measured about the performance of 5th grade students

participation rate of ICMS 2009 collection, as follows: 18% based on the municipal rate of educational quality - IQE, based on indicators of level and progress in the quality of the initial cycle of Basic Education - 5th grade of Elementary School (ES) - and literacy indicators in the first years of formal education - 2nd grade of ES The proportions of 1/3 for the IQF and 2/3 for the IQA were assigned, see (HOLANDA *et al.*, 2008)

The IQF is calculated from a component that measures the flow of students, given by the pass rate, and two other components that measure the quality of education related to students' performance in standardized exams *(Prova Brasil or SPAECE).* All variables are standardized on the same scale, between 0 and 1, about the results of other municipalities. The following weights are assigned: (i) 20% about the pass rate in the initial grades of Elementary School and (ii) 80% about students' performance in standardized exams. The variable related to standardized exams, there is a level component and a variation (or advance) component, to which different weights are attributed: 40% concerning the average grade of students in the 5th grade of elementary school; 60% with the advance in the average grade of students in the 5th grade of elementary school.

The IQA is calculated based on the results of the Literacy Exam for Students in the 2nd grade of Elementary School, carried out by the Ceará State Education Secretariat – SEDUC. Starting in 2007, the exam is applied to students annually to monitor children's literacy in the initial grades, assigning grades to all municipalities in Ceará. The IQA uses a methodology similar to the Elementary School Quality Index (IQF), as it relativizes and standardizes the variables and considers the level and advancement of literacy conditions for children in the municipality.

in Portuguese and mathematics tests; and (iii) 5% due to the average approval rate of students from the 1st to the 5th year.

4.3 Data

The dataset comprises two distinct components, each providing complementary information for analyzing the research question. To evaluate the impact of the *Quota-Parte* program on municipal expenditures, we rely on data sourced from the Municipal Finance database (FINBRA) maintained by the National Treasury Secretariat (STN). This dataset provides municipal-level variables, including population size, total municipal spending, education and primary education expenditures, municipal GDP, ICMS transfers, and federal intergovernmental transfers (FPM and FUNDEB). These variables were adjusted to real values using the IPCA-Fortaleza index, published by the Brazilian Institute of Geography and Statistics (IBGE), ensuring comparability over time. The analysis covers the period from 2004 to 2017. Additionally, the shares of ICMS revenue allocated to education, health, and the environment were obtained from the IPECEDATA database.

The educational data used in this analysis were sourced from the administrative records of the State Department of Education of Ceará (SEDUC/CE). Specifically, we consider student performance on standardized test scores for the 2nd grade of elementary education, as measured by SPAECE-Alfa. This assessment employs Item Response Theory (IRT), a methodology that enables comparisons across units sampled at different educational levels and over time. In addition to performance data, we incorporate information from the School Census, provided by the Educational Research Institute Anísio Teixeira (INEP), to include school-level and teacher-related variables. For further details, the Appendix presents the descriptive statistics of all variables (Table C2.1) and provides comprehensive definitions for each variable (Table C2.2). Furthermore, Table 14 offers a comparison of pre-treatment variables to ensure the robustness of the analysis.

Table 14 – Descriptive statistics for municipals based in rank (until 2008)

Variables	Mean		SD		t test	
	Rank =1	Rank =3	Rank =1	Rank =3	t value	p value
population size	70335.891	26998.836	314092.59	39134.395	2.3	.021
total spending	52108146	19977493	248005236.58	28291861	2.2	.03
spending on education	13273205	6758540.9	48489794	8633119.7	2.25	.026
spending on primary education	11058119	5340960.7	41791771	6809668.6	2.3	.022
GDP	466997.65	136773.67	2772825.3	359656.63	2	.046
FPM	12984601	17867090	21321547	59070341	-1.3	.188
FUNDEB	7589038.2	4234720.7	22728872	4990045.5	2.45	.015
IMCS Transfers	6866874	2727865.7	38014985	7335085.6	1.8	.07
non-education spending	38834941	13218952	199666293.72	19757256	2.15	.031

Note: Two-sample t test with equal variances with H_o: diff = 0 and H_a: diff $\neq 0; p-value \rightarrow Pr(|T| > |t|)$.

4.4 Impact of QLP on Municipal Public Spending

The empirical strategy is also divided into two parts. In the first part, we attempt to answer the following question: What is the impact of receiving more resources from the *Quota-Parte* program on educational and non-educational municipal expenditures? Our interest is to understand whether the *QLP* induces more spending on education, a desirable side effect. To answer this question, we use a difference-by-difference (DiD) strategy that exploits the prior educational quality of municipals before introducing the *Quota-Parte* program. Our equation of interest is as follows:

$$\Delta Y_{gmt} = \sum_{t=2004}^{2007} \beta_1 \Delta CP_{mt} \times I(m = Q_1) + \sum_{t=2009}^{2017} \beta_2 \Delta CP_{mt} \times I(m = Q_1) \times I(After) + \delta' X_{gmt} + \tau_m + \tau_t + \gamma_{mt} + \varepsilon_{mt} \tag{4.1}$$

Where: ΔY_{gmt} is the per capita difference in the spending's type g concerning 2008 value, at municipality m, and the year t. We fixed the population size in 2008 to avoid the population changes affecting the variables. This year is used as a reference because it is one year before the *Quota-Parte* program implementation. Then, the definition of ΔY_{gmt} is as follows:

$$\Delta Y_{gmt} = \frac{G_{gmt} - G_{gm,2008}}{Pop_{m,2008}} \tag{4.2}$$

$Ggmt$ is the specific spending's type g, at municipality m, and the year t. The ΔCP_{mt} refers to the difference between the revenue of the ICMS share at period t and the municipality m. It indicates the variation in ICMS redistribution by municipals concerning the values 2008.

$$\Delta CP_{mt} = \frac{CP_{mt} - C_{m,2008}}{Pop_{m,2008}} \tag{4.3}$$

We aim to understand whether the variation on *Quota-Parte* share affects the municipal spending composition. As before 2009, the ICMS resources were redistributed according to population criteria, such variable ΔCP_{mt} measures how much each municipality receives more or less after the introduction of the *Quota-Parte* program. The ICMS after 2009 was redistributed based on educational performances in 2007 and 2008. We exploit this criteria modification to assess the effect of the *Quota-Parte* share gains on educational spending.

The variable $I(m = Q_1)$ designates the treated municipals. That indicator variable assigns 1 to the municipalities with the best educational performance before implementing the *Quota-Parte* program in 2009. These municipalities are most likely to benefit from redistributing the ICMS after 2009. In addition, $I(m = Q_1)$ assigns zero to all other municipalities. We use the quality of education index (IQE) for 2009 (IQE_{m2009}) to define which municipals have the best educational level before the introduction of the *Quota-Parte* program. The IQE_{m2009} measures the aggregate performance of the municipals for 2007 and 2008. Thus, we considered treated municipalities at the top 30^{th} percentile (the 30% best-ranked municipalities). The remaining 70% were considered controls.

The choice of 30% best-ranked municipalities is central to understanding the heterogeneity in the impact of the policy and its potential to detect "gaming" behavior. Dividing municipalities into this way based on performance levels allows for a nuanced analysis of how reforms affect different groups. Focusing on the upper tercile makes it possible to identify variations in policy effectiveness and explore whether benefits are distributed equitably or concentrated among certain groups. This approach also aligns with efforts to detect strategic behaviors by municipalities, such as prioritizing resources for high-performing schools to maximize their overall metrics. Such actions, while potentially boosting aggregate performance, could increase inequality and undermine the policy's intended goal of broad systemic improvement.

This analysis provides insights into how municipalities with varying resources, sizes, and challenges respond to reforms. Moreover, focusing on terciles facilitates the detection of manipulative strategies. By comparing outcomes across terciles, it becomes possible to observe whether improvements are systemic or limited to specific segments of municipalities.

Our parameters of interest are β_2 that measure the impact of public spending in municipalities that likely present variation in the share of *Quota-Parte* (ΔCP). This parameter estimate changes according to a variation on ΔCP. We expect that a significant increase in the municipal share of *Quota-Parte* represents a rise in public spending.

The parameters β_1 are used as a falsification test. We expect the variation in these parameters to be insignificant, suggesting that the future changes in ΔCP did not correlate with previous changes in public spending.

Additionally, the vector X_{gmt} contains municipal-level controls, such as Municipal GDP, Other state and federal transfers, Ratio between the higher 10% and the 40% lower income (a measure of inequality), the proportion of the

population; aged for primary education, the proportion of older people, proportion of the urban population.

Finally, τ_t and τ_m are year and municipal fixed effects that absorb idiosyncratic temporal (economic shocks, droughts, etc.) and local variations. The public spending, in general, is strongly associated with the economic cycle of the respective municipalities. Municipalities may vary the expenditure according to the local economic cycle (ZIDAR, 2019). Thus, to control for the cycle variation, we introduce the fixed effects of the economic cycle of each municipality varying over time, γ_{mt}. We follow Zidar (2019) to estimate this cycle's economic fixed effect. Specifically, we estimate the variance of each municipality's annual growth rate of real GDP between 1999 and 2017. Subsequently, we clustered this variance measure into four groups characterizing different economic cycles for each municipality. Thus, we interacted with each group with the year variable in the equation (4.1). Standard errors were estimated at the municipality level.

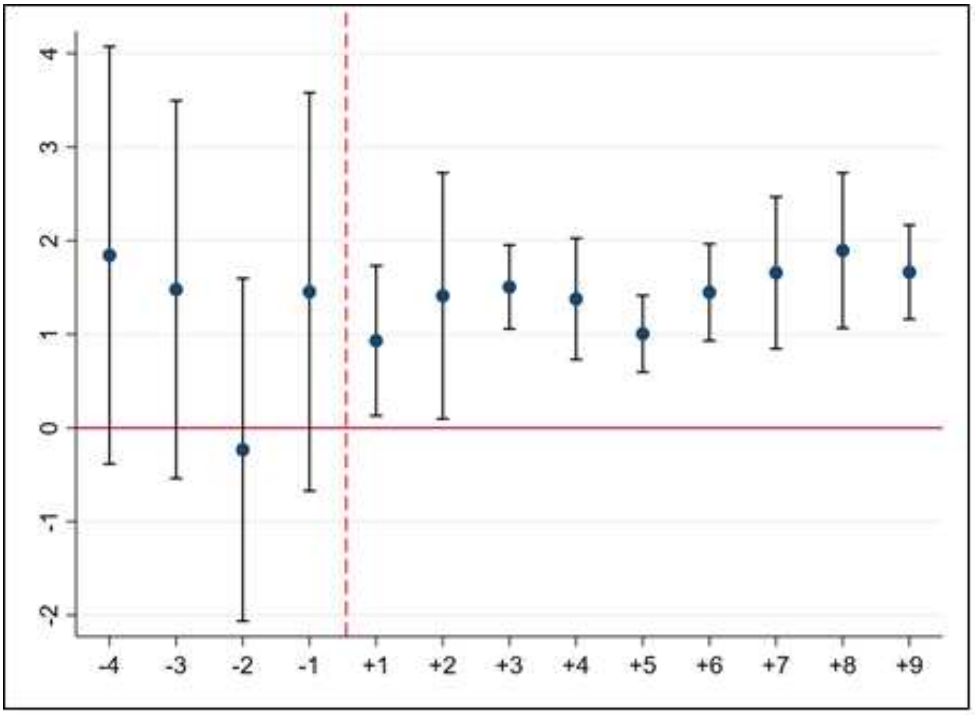
For this strategy to be valid, the predetermined variable $IQE_{m_{2009}}$ must meet two key conditions. First, it should be correlated with ΔCP_{mt} from 2009 onward. This condition is reasonable, as $IQE_{m_{2009}}$ reflects the performance of municipal education during 2007 and 2008, which served as the basis for determining the allocation of resources to municipalities once the *Quota-Parte* program began. Second, $IQE_{m_{2009}}$ must not have been influenced by municipalities' actions aimed at receiving more resources after the *Quota-Parte* program was implemented. This assumption is also plausible for two reasons: (1) Legislation 14.023, which established the new allocation criteria, was published in late 2007 (December 17, 2007). As a result, spending on education in 2007 could not have been influenced by the *Quota-Parte* program; and (2) while municipalities might have increased spending in 2008 to qualify for more resources in the following year, it is unlikely that a single year would be sufficient to bring about significant improvements in

municipal educational performance.

Under these assumptions, $IQE_{m_{2009}}$ serves as a valid measure of the resources municipalities would receive from 2009 onward. Furthermore, it is not associated with increased or decreased educational spending before the enactment of the *Quota-Parte* program. This ensures the validity of the strategy for analyzing the program's impact.

Figure 15 and Figure17 show the graphical results of the estimation of equation 4.1. Specifically, figure 15 refers to total municipal expenditure, and figure 17 relates to expenditure on education. In figure17, we present the total municipal spending in education, including all types of educational provision in Panel A. In Panel B, we are restricted to spending on elementary education. It is important to note that Elementary Education is the educational stage relevant to a municipal receiving more transfers from QLP.

Figure 15 – Effect on Total Expenditure of the Share *Quota-Parte* program



Note: Figure 15 presents the estimated impact of the introduction of *Quota Parte* program, denoted in a red vertical dash line. The results after implementation indicate that total municipal spending increased significantly. Such impact is persistent over time, suggesting that QLP produced long-term changes in the resources spent.

Initially, the estimates before implementing the *Quota-Parte* program (denoted by the vertical red dashed line) are not significant. It is favorable evidence for the hypothesis of parallel trends required for the validity of the difference-in-difference strategy. Estimates indicate no difference between the total expenditures of municipalities with high educational performance compared to other municipals before the introduction of the QLP. Thus, the intergovernmental transfers before 2008 do not explain the differences between the spending patterns among the municipalities. It is essential to note a large variance estimate before the QLP, suggesting a significant heterogeneity in the association between total municipal spending and intergovernmental transfers. After the program introduction, this

relationship becomes more precise.

The estimates after the program's introduction, we observe an increase in total municipal spending near R$1.62 per capita for each real received by the municipality due to the *Quota-Parte* program, to the municipal expenditure in 2008. This finding suggests that municipal spending raises more than the amount received by QLP. We report the point estimates in table 15.

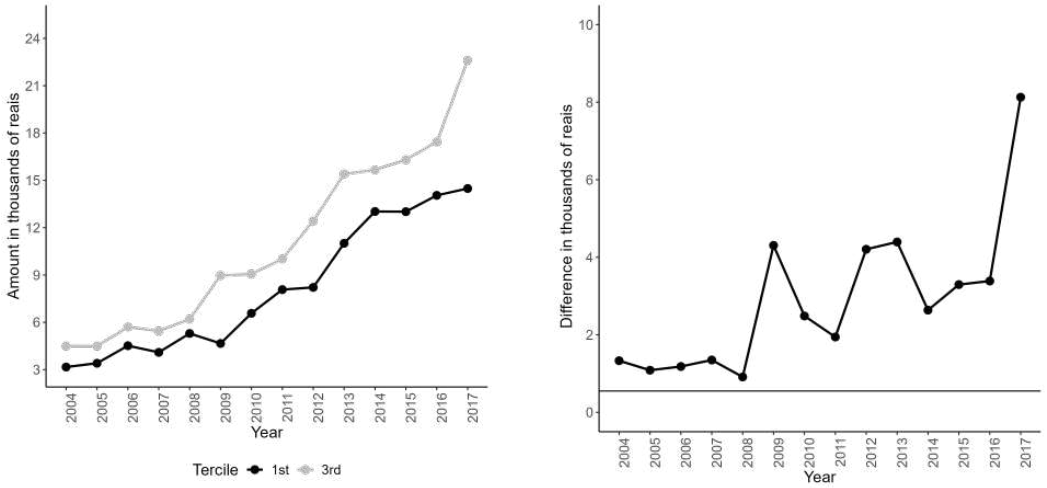
This result is related to the Flypaper Effect, according to which governments tend to spend more than the resources they receive from intergovernmental transfers[8]. In the case of QLP, the municipalities almost doubled their total spending in the face of an increase in transfers of resources.

In addition, and more importantly, such an increase in total spending is persistent over time, suggesting that QLP produced a long-term impact on the total resources spent by municipalities. That is also related to the total of transfers received by the municipals after the introduction of QLP. We observe that municipalities that benefited from QLP in 2009 kept receiving more resources than those that lost after the introduction of *Quota Parte* program. This can be observed in figure 16.

[8] The exact definition of the flypaper effect is that local governments increase public spending by more than increases in private income. There is extensive literature documenting this phenomenon; see: Hines e Thaler (1995), Inman (2008), Helm e Stuhler (2021). For the case of educational expenditure, see: Gordon (2004) and Cascio *et al.* (2013). For a discussion of Brazilian literature, see: Nojosa *et al.* (2018).

Figure 16 – Total intergovernmental transfers received by municipals

(a) Amount received by tercile (b) Difference between tercile



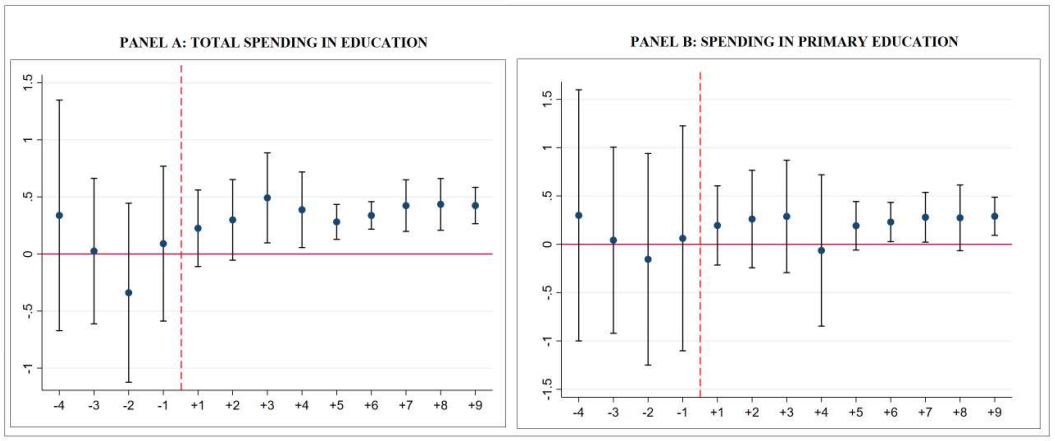
Note: Figure 16a presents the total of intergovernmental transfers received by municipals separated into two groups: Lower and higher tercile according to our primary measure of municipal educational achievement (IQE), and 16b presents the difference between first and third tercile.

We also divided the municipals according to lower and higher terciles in our municipal educational achievement (IQE) measure and calculated the total intergovernmental transfers received by each group. Figure A shows that the introduction of QLP in 2009 represented a persistent increase in the intergovernmental transfer received by the municipals with higher educational results. In turn, figure B presents the difference between the total intergovernmental transfers received by both groups and confirms that the introduction of *Quota Parte* program represented a persistent rise of resources allocating to municipals with higher performance before the program.

Figure 17 presents the results for spending on education and elementary education. The expenditure in education increased marginally due to the *Quota-Parte* program. The average estimate is 0.46 cents per capita for each real received by the share in 2009. However, spending on primary education did not present significant estimates after introducing the *Quota-Parte* program. On average, the

result for elementary education was an increase of 0.23 cents per capita for each real distribution. Thus, the QLP did not similarly increase the spending on education. Furthermore, more intergovernmental transfers from QLP did not increase spending on elementary education.

Figure 17 – Effect of the Share *Quota-Parte* program on Education and Elementary Education Spending



Note: Figure 17 presents two panels. In Panel A shows spending on education. It is noticed that expenditure increased due to LCP. Panel B shows that spending on primary education has not shown significant results almost every year (before and after LCP).

It is important to observe that the transfer from the QLP is not fungible. This means that municipals are not forced to spend the resources on education. However, the results presented likely represented an unintended side effect. In summary, the findings show that the municipalities that received more resources from *Quota-Parte* program spent less than they received on education. However, total spending increased significantly, more than the share of these municipalities initially redistributed compared to municipalities that did not benefit from the policy. Therefore, the QLP incentivizes the non-educational spending more than education spending for the municipalities benefiting from the program[9].

[9] The same exercise was performed considering the total expense subtracted from the educational expense, defined as non-educational spending. The estimates confirm the conclusions indicating

4.4.1 Robustness

In this subsection, we conduct two robustness exercises to assess the reliability of our findings. First, we introduce a comprehensive set of control variables that may influence municipal public expenditure, accounting for potential confounding factors. Second, we estimate an alternative economic cycle fixed effects based on the β-differencing approach of Blanchard *et al.* (1992). We also report the estimate of the main strategy presented in equation 4.1.

Table 15 shows the results. Columns (1), (4), and (7) refer to estimates of the main specification (equation 4.1). Columns (2), (5), and (8) show the estimates for a specification that includes a set of pre-determinant controls. These controls are Municipal GDP, Resources from the Municipality Participation Fund, Funds from FUNDEB, Ratio between the income of the wealthiest 10% and the most deficient 40% (a measure of inequality), the proportion of the population aged for primary education, the proportion of older people, proportion of the urban population. These variables may contribute to explaining the spending behavior. For example, municipalities with a large share of the older population or poverty may spend less on children policies (BURSZTYN, 2016).

Finally, columns (3), (6), and (9) present the results by replacing the municipal's cyclically-quartile-specific year fixed effect by β-differencing approach of Blanchard *et al.* (1992). We do not observe any significant difference in the estimates, suggesting that omitted variables do not drive the findings. The estimates suggest that an exogenous variation in the *Quota-part* share raises the total expenditure in a high magnitude; however, it presents a small size effect on educational spending.

that non-educational expenditure increased by approximately 1.45 reais per capita for each real received with the program. Such results are not reported in the article for concision but can be obtained by email to the authors.

Table 15 – Spent Robustness Results

Variables	Total Spend			Education Spending			Spending on Elementary Education		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Share Quota Transfers	1.627***	1.606***	1.670***	0.381***	0.382***	0.379***	0.258***	0.256***	0.256***
	(0.318)	(0.303)	(0.325)	(0.081)	(0.082)	(0.080)	(0.116)	(0.119)	(0.120)
Obs	2,345	2,291	2,291	2,345	2,291	2,291	2,345	2,291	2,291
R^2	0.921	0.921	0.911	0.913	0.914	0.911	0.719	0.721	0.713
Additional Controls	N	Y	Y	N	Y	Y	N	Y	Y
Year F.E.	Y	Y	Y	Y	Y	Y	Y	Y	Y
Municipal F.E.	Y	Y	Y	Y	Y	Y	Y	Y	Y
Cycle-per-year F.E.	Y	Y	N	Y	Y	N	Y	Y	N
β-differencing F.E.	N	N	Y	N	N	Y	N	N	Y

Note: Robust Standard Errors in parentheses (*** p<0.01, ** p<0.05, * p<0.1). Columns (1), (4), and (7) refers to estimates of the main specification. Columns (2), (5), and (8) show the estimates for a specification that includes aset pre-determinant controls. columns (3), (6), and (9) present the results by replacing the municipal's cyclically-quartile-specific year fixed effect by β-differencing approach of Blanchard *et al.* (1992).

4.5 Effect of QLP on Educational Outcomes

We also attempt to understand whether the impact of the *Quota-Parte* share differently affected the performance of schools in the 2nd year of elementary school. Evidence favoring this hypothesis may imply that QLP increases school inequality. To this end, we exploit the variability in the quality of schools within the municipals before the program's introduction, an approach similar to that used by Cilliers *et al.* (2021). In summary, we compare schools with similar performance before the *Quota-Parte* program in municipals earning more transfers from the QLP with those schools that lost resources.

In 2007, the SPAECE-Alfa test was applied to all students in the 2nd year of elementary school. Based on this test, schools in each municipality of Ceará's state (184 municipals) were divided into two categories according to their average performance: lower and higher achievers school. Lower achievers schools had an average performance in test scores below the median of schools in their municipal. On the other hand, higher achievers schools had an average performance above the median of all schools in their municipal. These categories will be indexed at $k = 1$ and 2 to facilitate exposure.

The goal is to verify if there are significant differences in performance test scores among the schools of each category in municipalities that in 2009 earned more or less with the introduction of the *Quota-Parte* program. The benefited municipalities from QLP were obtained by ranking the $IQE_{m_{2009}}$ similarly to the empirical exercise in Section 4. The municipalities that earned with the program are in the 33rd largest percentile (treated group), and the Neutral municipalities are between the 34th and 65th percentile. Finally, the municipalities that likely lost with the *Quota-Parte* are in the 66th to the 100th percentile (control group). Let $I(CP_m) = 1$ if municipality m is in the treated group and $I(CP_m) = 0$ if municipality m belongs to the control group. The neutral group is excluded to avoid collinearity.

Consider y_{imt} the average performance in standard deviation of schools i in SPAECE-Alfa of municipality m, at period t. Additionally, consider the categories $k = 1,2$ above defined. The empirical equation to be estimated for the second exercise is:

$$y_{imt} = \beta_0 + \sum_{k=1}^{2} \beta_k \times I(CP_m) + \delta' X_{imt} + \tau_t + \theta_m + u_{imt} \tag{4.4}$$

The β_k is the parameter of interest and measured the effect of a given municipality in the treated group compared to the control group for each category $k = 1,2$ of schools. The parameters τ_t and θ_m are the year and municipal fixed effects, respectively. Standard errors were estimated at the school level.

The empirical strategy identifies the causal effects for two reasons. First, the introduction of the *Quota-Parte* program at the end of 2007 likely did not affect the performance of schools in that same year, as the SPAECE-Alfa exam was applied before the promulgation of the *Quota-Parte* program. Second, introducing the QLP can be considered exogenous to the educational performance of schools in

each municipality. That is, before introducing the *Quota-Parte* program, schools had differences in educational performance that are not correlated with future inter-municipal state transfer programs. It is important to note that we are not comparing lower and higher achievers schools in different municipalities. However, lower and higher schools are differentiated within the same municipals. This guarantees the validity of the second assumption.

A threat of the identification stems from the possibility that schools between categories $k = 1,2$ were different before the QLP. Two strategies have been adopted to overcome this problem. First, we consider a large set of predetermined school-level controls, represented by the vector X_{imt}. This allows absorption for observable differences among the schools measured before introducing the QLP. Second, we use the balanced entropy method, developed by Hainmueller (2012), to pair the schools through the predetermined variables. The pairing method allows for comparing homogeneous schools.

The division of municipalities into terciles and schools around the median is an effective strategy for capturing the heterogeneity in the effects of the QLP on educational outcomes. By grouping municipalities into terciles based on their performance, it becomes possible to analyze whether the policy benefits are uniformly distributed or concentrated among specific groups. For example, municipalities in the lower tercile may face significant structural and resource challenges, limiting their capacity to utilize the additional funding provided by the QLP fully. In contrast, those in the upper tercile might have better pre-existing infrastructure and management practices, enabling them to leverage the financing more effectively and improve educational outcomes.

Similarly, dividing schools around the median adds another layer of analysis to explore heterogeneity within municipalities. Schools above the median often represent those with better pre-existing conditions. These schools are likely

better positioned to absorb additional resources and translate them into improved student outcomes. On the other hand, schools below the median may require more targeted interventions as they face systemic challenges that limit their ability to achieve comparable improvements. This approach ensures that the analysis considers municipal and school-level differences, providing a more comprehensive view of how the QLP impacts educational outcomes.

The combined use of terciles for municipalities and the median for schools highlights the complex dynamics of educational policy implementation. Examining these divisions makes it evident that policies like the QLP do not operate in a vacuum; the pre-existing characteristics of the municipalities and schools shape their effects. This analysis can uncover disparities in policy effectiveness, offering insights into how funding allocation mechanisms might inadvertently favor already-advantaged municipalities and schools, potentially exacerbating inequalities. At the same time, this framework can help identify where additional support or tailored interventions are needed to ensure that underperforming municipalities and schools also benefit from the policy.

Ultimately, this approach underscores the importance of considering heterogeneity in policy evaluation. Policymakers can design more effective and equitable educational interventions by recognizing and analyzing the differences between groups. It allows for a deeper understanding of the mechanisms through which the QLP influences outcomes and provides actionable insights for improving the policy's reach and impact across diverse contexts.

We analyze if the effect of the *Quota Parte* program is homogeneous among the schools within the municipals on the school average performance at 2nd grade. We compare schools from municipals that have benefited from the introduction of the QLP relative to similar schools in municipals that received less after the QLP. We consider the median of the average performance at 2nd grade in

2007 to differentiate the schools between the higher and lower-performing schools. The results are presented in terms of standard deviations, and we also control for time and municipal fixed effects.

Table 16 presents the estimation results of Equation 4.5. The result in Column (1) compares the lower-performing schools in municipals with different transfer gains. In this turn, Column (2) compares higher-performing schools in municipals in the gradient of gains with QLP. Indeed, we are analyzing how these QLP gains have heterogeneous effects on schools above and below the median performance within the municipals.

The results suggest that higher-performing schools increase their average test scores by introducing QLP (category $k = 2$). However, lower-performing schools present little differences according to QLP gains. This result indicates that inequality among the schools within the municipals increased after the introduction of QLP.

There is a potential explanation for these estimates. First, the mayor allocated different resources to the municipal schools. They prefer to spend time in schools, where they have more potential to perform well. We will verify this possibility in the next section.

Table 16 – Educational Results

	k=1	k=2
Treatment	0.537	1.112***
	(0.340)	(0.376)
Obs	10,120	10,200
R^2	0.689	0.551
Municipal F.E.	Y	Y
Year F.E.	Y	Y

Note: Robust Standard Errors in parentheses (*** p<0.01, ** p<0.05, * p<0.1) k=1 ->Lower school median + 3rd tertile cp in relation to 1st tertile cp . k=2 ->Upper median school + 3rd tertile cp in relation to 1st tertile cp

4.5.1 Robustness

An important issue associated with the estimates in table 16 is the possibility that schools in different municipalities differ in each median. That is, schools with low (or high) performance in 2007 in municipalities that will benefit from the *Quota-Part* program may not be directly comparable to schools with low (or high) performance in municipals that will lose resources with the QLP. To overcome this limitation, two robustness exercises are performed.

The first exercise uses a rich set of control measures at the school level. These measures relate to the quality of the educational offer (such as teacher quality indicators and the number of students) and the characteristics of students, average literacy rate, and a measure of school delay, among others. Importantly, all these covariates were predetermined and measured in 2007, before the introduction of the QLP.

The second exercise applies entropy matching Hainmueller (2012) considering the same predetermined variables used in the previous exercise. The pairing increases the similarity between schools through the assigned weights, enabling an

adequate comparison between treaties and control groups. Both procedures are intended to allow such schools to be comparable in each category, k.

Table 17 – Educational robustness results

Panel A: Adding Controls	k=1	k=2
Treatment	0.498	1.631***
	(0.440)	(0.518)
Obs	8,389	8,648
R^2	0.702	0.575
Panel B: Matching by Entropy	k=1	k=2
Treatment	0.327	1.116***
	(0.354)	(0.393)
Obs	8,389	8,648
R^2	0.718	0.604
Municipal F.E. by Cohort	Y	Y
Year F.E.	Y	Y

Note: Robust Standard Errors in parentheses (*** p<0.01, ** p<0.05, * p<0.1) The treatment parameter analyzes the impact of the interaction between schools' proficiency and the transfer of the quota, previously part of the change in legislation. Each column represents a median of proficiency (lowest performance (1) to upper performance (2), respectively). The median is associated with the transfer of LCP (municipalities most benefited with the affected ones) in order to be able to define the treatment variable.

The results present similar estimations concerning table 17. Lower-performing schools are not affected by the introduction of *Quota-Part* program. However, the higher-performing schools increased their average educational performance after implementing the QLP.

4.6 Mechanisms

A potential explanation for the previous results is that the municipal resource allocation differs according to the school's productivity. We refer to school productivity as the capacity of the school to use the available resources

to increase the average performance of its students. The mayor may not prefer schools with lower productivity over those schools that use public expenditure with higher productivity. Under the differences in the school's capacity to raise student performance, the mayor may have incentives to increase school resources that allowed a superior gain from the QLP program.

To verify this hypothesis, we estimate a model similar to Equation 4.5, replacing the dependent variable for indicators of school supply that may suggest more lavish spending in a specific school. We consider ten school-level variables: Management Complexity, Teacher's Adequacy, Teacher's Effort I, II, and III; Teacher's Regularity, Students per Class, and Teacher with a College Degree. To avoid multiple testing issues, we aggregate the outcomes using the principal component analysis (PCA) of those variables[10].

The variables are standardized to have mean zero and variance one, except for student per class and class duration. The results are available in table 18. It is important to note that those variables are related to the supply and quality of public education. Then, a heterogeneous variation of QLP program on those variables may indicate that mayors selected schools with different performances to spend the municipal resources.

The indicators of management complexity, teacher's adequacy, teacher's effort I and II, students per class[11] and class duration were not significant. However, the signal of the estimates and the difference in magnitudes support our hypothesis that schools within municipalities are selected to receive more grants.

Teacher Effort III, teacher regularity, and the proportion of teachers with a college degree are statistically significant in our analysis. The results for teacher effort indicate that schools above the median tend to attract more qualified

[10] The detailed description of these variables is found in table C2.3, available in Appendix

[11] For the measurement of students per class, we use one divided by the average of students per class. This strategy allows us to interpret the results more clearly and with an increasing scale.

teachers, leading to lower student-to-teacher ratios, fewer classes per teacher, and reduced teacher turnover. In contrast, teacher regularity appears relatively similar between higher- and lower-performing schools, suggesting that attendance patterns may not vary significantly across these groups. These findings may reflect structural features of the public education system—particularly the teacher selection process in public service, which may channel more experienced or better-qualified teachers toward schools with stronger management or better reputations.

Teachers with a college degree are significant for both groups; however, they are only positive for the lower median, indicating that schools in this position invest in teachers with a university degree, regardless of training. Higher-performing schools already had a large share of teachers with tertiary education, suggesting that the new teachers are hired to lower-performing schools.

The variable that uses principal component analysis (PCA) is negative; however, it is significant for the higher-performing schools. These results complement the previous estimates, suggesting that the available resources are allocated differently in schools with better prior performance. The negative sign of the PCA estimate indicates a rise in the spending on higher-performing schools to lower-performing ones when the introduction of *Quota-Part* program.

Table 18 – Mechanisms Results

	Management Complexity		Teacher's Adequacy		Teacher's Effort I		Teacher's Effort II		Teacher's Effort III	
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
treatment	0.500	0.160	1.062	-0.274	0.203	0.284	0.203	0.284	-0.770***	-0.802*
	(0.435)	(0.298)	(0.683)	(0.384)	(0.418)	(0.238)	(0.418)	(0.238)	(0.247)	(0.464)
Obs	2,404	2,513	2,179	2,373	2,179	2,373	2,179	2,373	2,179	2,373
R^2	0.339	0.306	0.442	0.406	0.312	0.271	0.312	0.271	0.382	0.382
	Teacher's Regularity		**Students per Class**		**Class Duration**		**Teacher's with College Degree**		**(PCA)**	
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
treatment	0.895**	0.825***	-0.014	-.0007	2.540	-3.037	0.421**	-1.099***	-0.012	-1.488***
	(0.401)	(0.292)	(0.109)	(0.875)	(0.672)	(0.255)	(0.202)	(0.005)	(0.098)	(0.005)
Obs	2,395	2,513	1,571	1,848	1,703	2,029	1,631	1,692	1,188	1,274
R^2	0.370	0.382	0.414	0.318	0.699	0.638	0.444	0.424	0.003	0.547
Municipal and Year F.E.	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Matching by Entropy	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

Note: Robust Standard Errors in parentheses (*** p<0.01, ** p<0.05, * p<0.1). The variables are standardized to have mean zero and variance one, except for student per classand class duration, those variables arerelated to the supply and quality of public education. A heterogeneous variation of QLP program on those variables may indicate that mayors selected schools with different performances to spent the municipal resources.

4.7 Conclusion

This chapter examined the impact of the QLP, which allocates intergovernmental transfers based on educational performance. It focused on two aspects not previously explored in the literature: the allocation of municipal public expenditures and the implications for academic performance inequality among second-year elementary schools. Unlike prior studies focusing on the broader outcomes of educational financing reforms (LOUREIRO *et al.*, 2020; LAUTHARTE *et al.*, 2021; CARNEIRO *et al.*, 2022). This research investigates how these transfers are distributed within municipalities and their heterogeneous impacts at the school level.

Our findings reveal that municipalities benefiting from the QLP allocated a more significant portion of their resources to non-educational expenditures. While spending on education modestly increased following the program's implementation, spending on primary education specifically remained unaffected. This result aligns with findings by Carneiro e Irffi (2018), Brandão (2014a), who observed that the discretionary nature of intergovernmental transfers often allows municipalities to

redirect funds toward non-educational priorities. Although the program's primary objective is not to earmark education funds, as noted by Silva (2021), it was anticipated that performance-based financial incentives might indirectly encourage municipalities to prioritize educational spending. However, this expected side effect was not realized.

Further, we analyzed the educational impact of the QLP within municipalities and uncovered significant disparities. Only schools with better pre-existing performance levels improved their test scores in municipalities benefiting from the program. This outcome resonates with findings by Lautharte *et al.* (2021), who emphasized the risk of performance-based policies reinforcing existing inequalities. The QLP's design, which rewards aggregate municipal performance, inadvertently favored higher-performing schools, increasing inequality within municipalities. These results are consistent with studies by Batista (2020), Irffi *et al.* (2021), Carneiro e Irffi (2018), which highlight the need for equitable mechanisms in performance-based educational funding.

Our investigation into school-level variables further supports this hypothesis. The results suggest that mayors tended to allocate more resources to schools demonstrating higher productivity in utilizing public funds, a pattern also identified by Carneiro *et al.* (2022). This selective allocation underscores a critical trade-off in incentive-based programs like the QLP. While they reward efficiency, they risk neglecting underperforming schools, which require more support to bridge performance gaps.

In conclusion, the QLP's implementation did not induce municipalities to significantly increase educational spending and instead contributed to widening inequalities in educational performance within municipalities. These findings provide important policy implications. To prevent similar programs from exacerbating intra-municipal disparities, future performance-based incentive schemes should

incorporate mechanisms to ensure equitable resource allocation, as Silva (2021), Carneiro e Irffi (2018) suggested. For example, complementary policies could target support toward lower-performing schools or impose conditions on fund distribution to balance efficiency with equity. By addressing these gaps, such programs can better achieve their intended goals of improving overall educational outcomes without fostering inequality.

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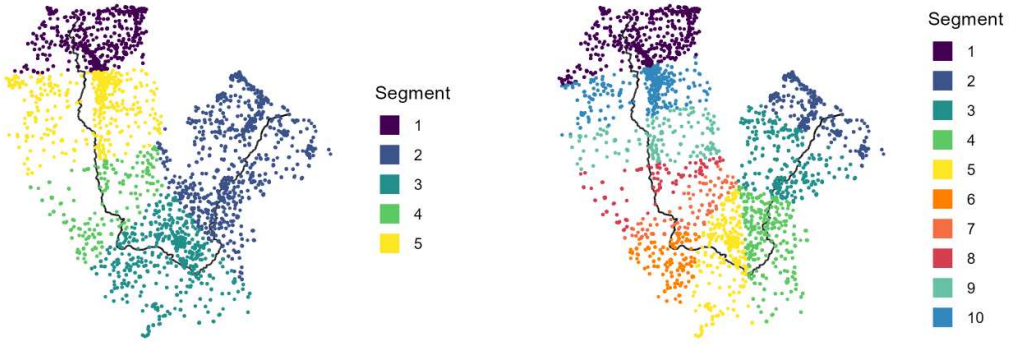
APPENDIX A – CHAPTER 2

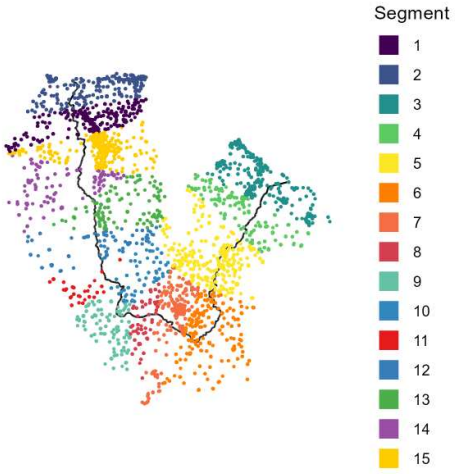
A1 - Border Segments

Figure A1.1 – Border segments created by the SRD method

(a) Border Segment - 5 (b) Border Segment - 10



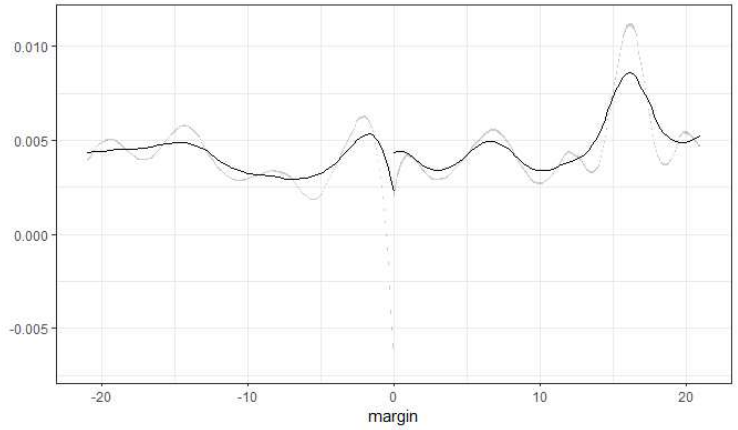
(c) Segment 15



Note: Panels (a), (b), and (c) show border segments created by the SRD method, with increasing levels of segmentation: 5, 10, and 15 segments, respectively. Each distinct color in these panels represents a different distance segment from the border, with the black line indicating the Ceará border. The finer segmentation allows for a more granular understanding of the spatial relationship between units and the border, which is critical for assessing potential border effects.

A2 - Additional figures

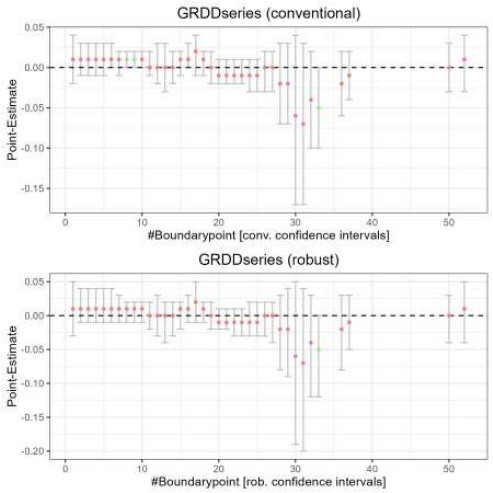
Figure A2.1 – Mccray test for change in student composition in 2007 to 2017



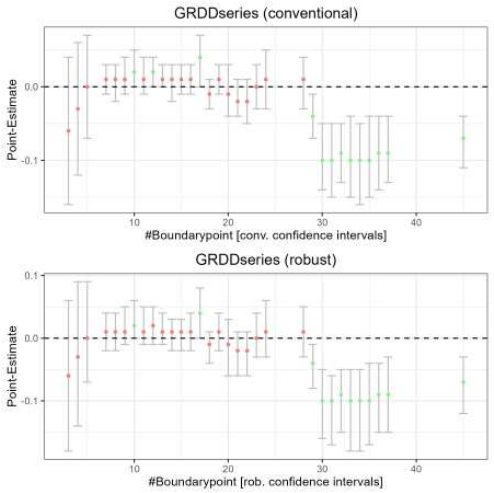
Note: Figure A2.1 presents the McCrary plot, which shows the density of students at the margin. The result of the McCrary test was 0.496, indicating no discontinuity at the cutoff.

Figure A2.2 – Spatial RDD - Plots of the estimation in each year

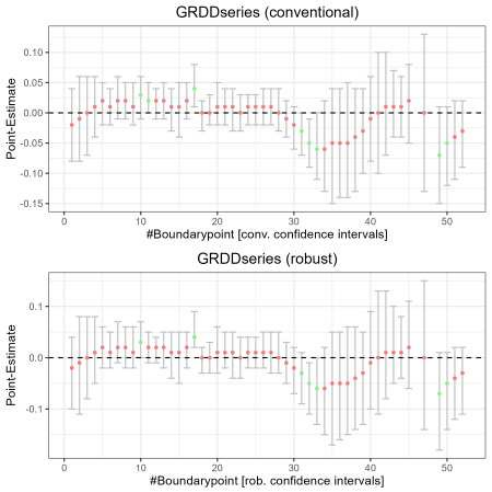
(a) SQMI 2007 - mean result (-0.005)



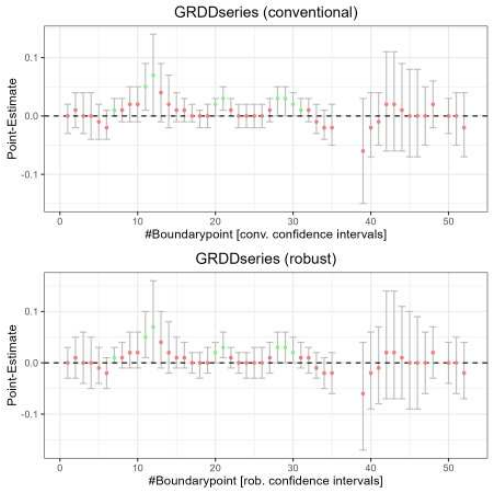
(b) SQMI 2009 - mean result (-0.026)



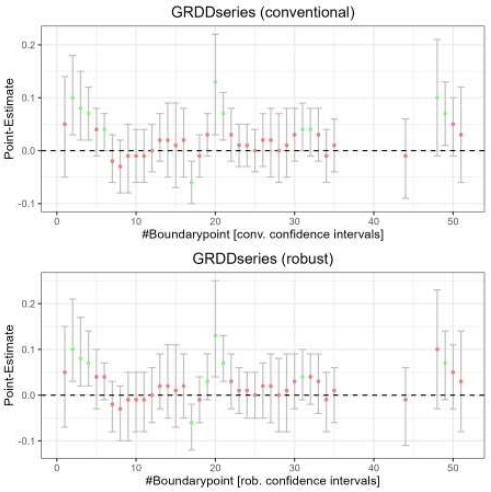
(c) SQMI 2007/2009 - mean result (-0.006)



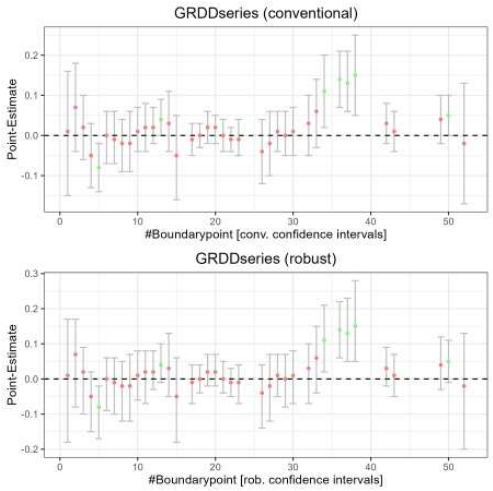
(d) SQMI 2011 - mean result (0.007)



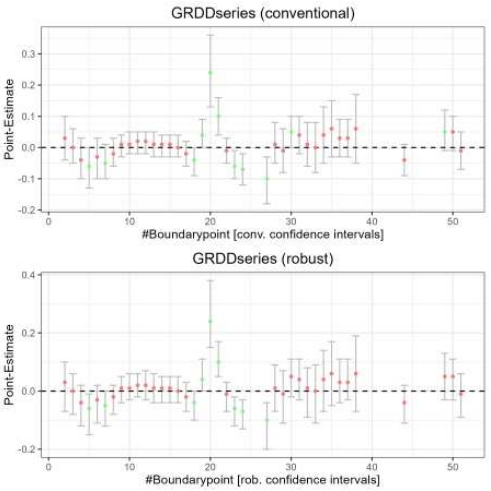
(e) SQMI 2013 - mean result (0.025)



(f) SQMI 2015 - mean result (0.018)



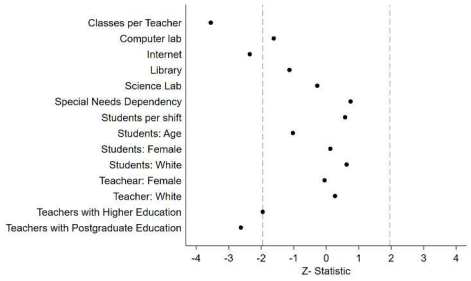
(g) SQMI 2017 - mean result (0.009)



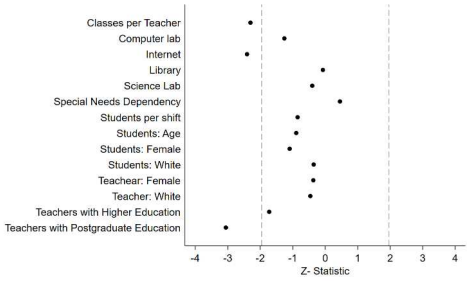
Note: Results SQMI index for each year. The estimation used control variables. By choice, the authors decided to omit the results. Significance values for $p < 0.05$.

Figure A2.2 – Balance Covariates

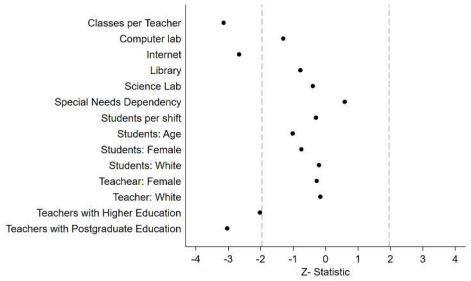
(a) SQMI 2007



(b) SQMI 2009

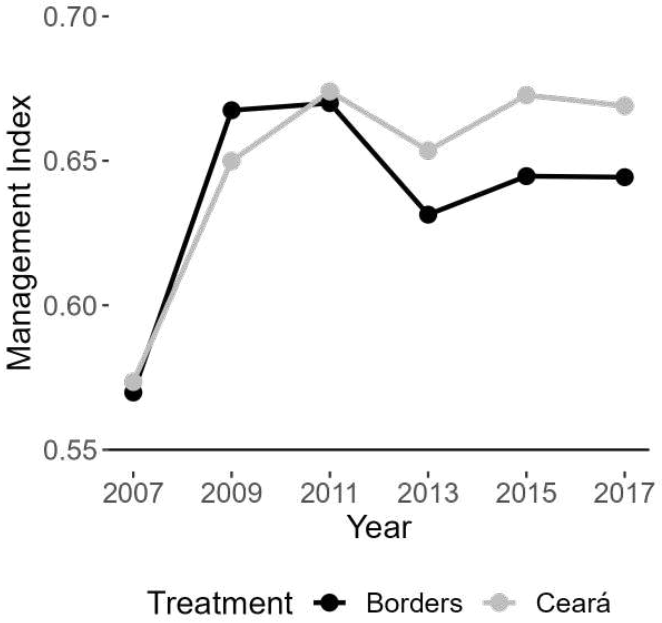


(c) SQMI 2007/2009



Note: In figure (a), the covariate balance is assessed using variables from the 2007 estimation. In figure (b), the balance is evaluated using variables from the 2009 estimation. In figure (c), the covariate balance is analyzed using variables from the 2007/2009 estimations. All these periods occur prior to the treatment.

Figure A2.3 – Evolution of the Management Index of Treatment (2007-2017)



Note: Figure A2.3 highlights a positive but uneven improvement in management practices across Ceará and Borders from 2007 to 2017. While Ceará has shown more consistent and rapid progress, essentially because of the TA and RBF mechanism, borders have experienced slower improvements or occasional declines.

A3 - Additional tables

Table A3.1 – Data Description: Variables used in Estimation

Variable	Description	Source
SQMI	School Management Quality Index	SAEB
White Students	Dummy indicating if the student identified as white in 2007	SAEB
Race Not Declared Students	Dummy indicating if the student did not declare their race in 2007	SAEB
Female Student	Dummy indicating if the student who took the test was female in 2007	SAEB
Age	Age of the student who took the test for each grade in 2007	SAEB
Students per Class	Average number of students per class in each school in 2007	School Census
Special Needs Facilities	Dummy indicating if the school's facilities and pathways were adequate for students with disabilities or reduced mobility in 2007	School Census
Computer Lab	Dummy indicating if the school had a computer lab in 2007	School Census
Science Lab	Dummy indicating if the school had a science lab in 2007	School Census
Special Education Classroom	Dummy indicating if the school had a specific room for Specialized Educational Assistance in 2007	School Census
Sports Court	Dummy indicating if the school had a sports court in 2007	School Census
Library	Dummy indicating if the school had a library/reading room in 2007	School Census
Internet Access	Dummy indicating if the school had internet access in 2007	School Census
Female Teacher Percentage	Percentage of female teachers per school in 2007	School Census
White Teacher Percentage	Percentage of teachers who identified as white per school in 2007	School Census
Race Not Declared Teacher Percentage	Percentage of teachers who did not declare their race per school in 2007	School Census
Postgraduate Teacher Percentage	Percentage of teachers with postgraduate degrees per school in 2007	School Census
Classes per Teacher	Average number of classes each teacher had to teach in the school in 2007	School Census

Notes: SAEB variables are at the student level, while Census variables are at the school level.

Table A3.2 – Descriptive Statistics - 2007 to 2017, comparing Treatment, Control, and Overall.

	Treatment			Control			Overall				
	Obs	Mean	SD	Obs	Mean	SD	Mean	SD	Min	Median	Max
Management Index	6272	0.665	0.060	4835	0.629	0.069	0.649	0.067	0.191	0.655	0.992
Students per shift	6272	24.191	5.276	4835	25.301	7.322	24.674	6.273	5.538	24.5	137.5
Students: White	6272	0.073	0.109	4835	0.060	0.087	0.067	0.100	0	0.029	0.823
Students: Female	6272	0.474	0.041	4835	0.482	0.046	0.477	0.043	0.118	0.477	0.778
Students: Age	6272	11.229	1.372	4835	11.475	1.909	11.336	1.632	6.333	11.33	19.612
Special Needs Dependency	6272	0.093	0.291	4835	0.086	0.280	0.090	0.286	0	0	1
Computer lab	6272	0.097	0.296	4835	0.137	0.344	0.115	0.318	0	0	1
Science Lab	6272	0.008	0.088	4835	0.013	0.112	0.010	0.099	0	0	1
Library	6272	0.492	0.500	4835	0.367	0.482	0.438	0.496	0	0	1
Internet	6272	0.154	0.361	4835	0.155	0.362	0.155	0.362	0	0	1
Teacher: Female	6272	0.838	0.141	4835	0.848	0.137	0.843	0.140	0	0.864	1
Teacher: White	6272	0.141	0.167	4835	0.119	0.146	0.132	0.159	0	0.083	1
Teachers with Higher Education	6272	0.618	0.266	4835	0.619	0.266	0.618	0.266	0	0.667	1
Teachers with Postgraduate Education	6272	0.090	0.134	4835	0.128	0.177	0.106	0.155	0	0.053	1
Classes per Teacher	6272	2.805	1.345	4835	3.106	1.669	2.936	1.502	1	2.737	10.45

Table A3.3 – Descriptive Statistics - 2011 to 2017, comparing Treatment, Control, and Overall.

	Treatment			Control			Overall				
	Obs	Mean	SD	Obs	Mean	SD	Mean	SD	Min	Median	Max
Management Index	5047	0.668	0.065	3025	0.647	0.069	0.660	0.067	0.229	0.664	0.992
Students per shift	5047	24.107	5.353	3025	24.877	7.553	24.395	6.279	5.538	24.25	137.5
Students: White	5047	0.073	0.109	3025	0.056	0.081	0.067	0.099	0	0.028	0.823
Students: Female	5047	0.474	0.041	3025	0.482	0.049	0.477	0.044	0.118	0.477	0.778
Students: Age	5047	11.223	1.375	3025	11.516	1.973	11.333	1.631	6.333	11.331	19.612
Special Needs Dependency	5047	0.095	0.293	3025	0.074	0.262	0.087	0.282	0	0	1
Computer lab	5047	0.097	0.296	3025	0.122	0.327	0.107	0.309	0	0	1
Science Lab	5047	0.008	0.086	3025	0.012	0.107	0.009	0.095	0	0	1
Library	5047	0.491	0.500	3025	0.302	0.459	0.420	0.494	0	0	1
Internet	5047	0.154	0.361	3025	0.125	0.331	0.143	0.350	0	0	1
Teacher: Female	5047	0.840	0.141	3025	0.846	0.141	0.842	0.141	0	0.857	1
Teacher: White	5047	0.141	0.167	3025	0.109	0.139	0.129	0.158	0	0.083	1
Teachers with Higher Education	5047	0.619	0.265	3025	0.595	0.276	0.610	0.270	0	0.667	1
Teachers with Postgraduate Education	5047	0.090	0.135	3025	0.126	0.180	0.103	0.154	0	0.047	1
Classes per Teacher	5047	2.802	1.349	3025	3.107	1.683	2.917	1.490	1	2.725	10.45

Table A3.4 – Balance of baseline variables - SQMI 2007

Variable	RD Effect	Robust p-val	Robust Conf. Int.	Bandwidth	Eff. Number Obs	Obs	z
Students per shift	0.966	0.561	[-2.29, 4.221]	33.013	471	1313	0.581
Students: White	0.015	0.530	[-0.033, 0.063]	30.825	434	1313	0.627
Students: Female	0.001	0.900	[-0.02, 0.023]	35.495	522	1313	0.126
Students: Age	-0.531	0.304	[-1.545, 0.482]	34.741	500	1313	-1.027
Special Needs Dependency	0.055	0.454	[-0.089, 0.2]	25.507	286	1313	0.749
Computer lab	-0.220	0.106	[-0.487, 0.047]	36.547	534	1313	-1.616
Science Lab	-0.008	0.783	[-0.066, 0.05]	45.382	663	1313	-0.276
Library	-0.164	0.258	[-0.447, 0.12]	34.481	496	1313	-1.132
Internet	-0.361	0.019	[-0.662, -0.061]	38.487	559	1313	-2.355
Teacher: Female	-0.002	0.960	[-0.077, 0.073]	35.104	511	1313	-0.051
Teacher: White	0.012	0.787	[-0.073, 0.096]	35.161	513	1313	0.270
Teachers with Higher Education	-0.129	0.050	[-0.259, 0]	32.811	467	1313	-1.956
Teachers with Postgraduate Education	-0.165	0.009	[-0.287, -0.042]	32.279	461	1313	-2.629
Classes per Teacher	-1.152	0.000	[-1.787, -0.517]	26.093	299	1313	-3.555

Table A3.5 – Balance of baseline variables - SQMI 2009

Variable	RD Effect	Robust p-val	Robust Conf. Int.	Bandwidth	Eff. Number Obs	Obs	z
Students per shift	-1.493	0.395	[-4.929, 1.944]	34.766	702	1722	-0.851
Students: White	-0.007	0.723	[-0.048, 0.033]	27.578	488	1722	-0.355
Students: Female	-0.011	0.273	[-0.032, 0.009]	33.607	664	1722	-1.096
Students: Age	-0.346	0.372	[-1.106, 0.413]	30.085	575	1722	-0.893
Special Needs Dependency	0.025	0.650	[-0.082, 0.131]	24.285	401	1722	0.453
Computer lab	-0.125	0.208	[-0.319, 0.070]	39.451	789	1722	-1.258
Science Lab	-0.011	0.689	[-0.062, 0.041]	39.535	789	1722	-0.400
Library	-0.008	0.943	[-0.215, 0.200]	33.541	663	1722	-0.072
Internet	-0.301	0.016	[-0.546, -0.056]	33.256	650	1722	-2.408
Teacher: Female	-0.012	0.714	[-0.077, 0.053]	36.186	734	1722	-0.367
Teacher: White	-0.017	0.646	[-0.091, 0.056]	33.898	671	1722	-0.459
Teachers with Higher Education	-0.138	0.085	[-0.295, 0.019]	36.014	730	1722	-1.725
Teachers with Postgraduate Education	-0.172	0.002	[-0.282, -0.062]	39.072	785	1722	-3.059
Classes per Teacher	-0.694	0.021	[-1.285, -0.103]	35.440	719	1722	-2.302

Table A3.6 – Balance of baseline variables - SQMI 2007/2009

Variable	RD Effect	Robust p-val	Robust Conf. Int.	Bandwidth	Eff. Number Obs	Obs	z
Students per shift	-0.515	0.768	[-3.926, 2.897]	31.468	1050	3035	-0.296
Students: White	-0.004	0.838	[-0.046, 0.038]	27.495	827	3035	-0.204
Students: Female	-0.007	0.455	[-0.025, 0.011]	35.912	1254	3035	-0.747
Students: Age	-0.408	0.310	[-1.195, 0.380]	31.922	1076	3035	-1.015
Special Needs Dependency	0.035	0.555	[-0.081, 0.152]	26.018	738	3035	0.590
Computer lab	-0.147	0.192	[-0.367, 0.073]	40.199	1374	3035	-1.305
Science Lab	-0.011	0.695	[-0.065, 0.043]	41.931	1418	3035	-0.392
Library	-0.084	0.437	[-0.297, 0.128]	30.348	1003	3035	-0.778
Internet	-0.377	0.008	[-0.655, -0.100]	32.264	1090	3035	-2.667
Teacher: Female	-0.008	0.786	[-0.068, 0.052]	35.257	1229	3035	-0.272
Teacher: White	-0.006	0.872	[-0.077, 0.066]	37.541	1303	3035	-0.161
Teachers with Higher Education	-0.140	0.043	[-0.276, -0.004]	32.827	1110	3035	-2.024
Teachers with Postgraduate Education	-0.171	0.002	[-0.282, -0.061]	37.104	1287	3035	-3.034
Classes per Teacher	-0.836	0.002	[-1.357, -0.315]	31.318	1046	3035	-3.144

Table A3.7 – Student Composition by Location of Birth, Residence, and Study: 2007-2017

UF	2007	2009	2011	2013	2015	2017
Lives in the city where they were born						
PI	53.3%	61.0%	55.4%	54.2%	53.3%	47.6%
CE	76.0%	76.2%	75.2%	73.5%	70.4%	68.4%
RN	54.3%	55.5%	53.3%	53.0%	49.1%	41.7%
PB	56.2%	57.0%	57.2%	48.8%	48.8%	43.5%
PI	63.7%	62.5%	66.9%	65.7%	64.7%	61.4%
Studies in the city where they live						
PI	93.4%	93.6%	94.5%	98.5%	97.8%	98.2%
CE	97.3%	96.1%	96.3%	97.4%	97.1%	98.4%
RN	94.2%	93.3%	95.4%	97.1%	97.2%	97.1%
PB	95.9%	93.7%	95.3%	96.3%	95.9%	96.7%
PI	95.7%	94.4%	95.6%	95.8%	96.5%	97.6%
Studies in the same state where they live						
PI	95.0%	96.2%	96.8%	99.5%	99.1%	99.0%
CE	98.9%	99.2%	99.1%	99.3%	99.3%	99.4%
RN	98.0%	98.7%	99.2%	99.2%	99.2%	99.0%
PB	98.6%	98.2%	99.3%	99.8%	99.5%	99.1%
PI	98.2%	97.8%	99.1%	98.3%	98.7%	99.2%

Notes: The table represents changes in student composition by location (city of birth, city of residence, and state of residence) over time (2007-2017) for the states of PI, CE, RN, and PB. The table shows the percentage of students living in the city where they were born, studying in the city where they live, and studying in the same state where they live.

Table A3.8 – RDD estimation - Results for Linear, Quadratic, and Cubic Specifications across different years

	11-17	07	09	11	13	15	17
Panel A: Linear Specification							
Rd Estimator	0.012	0.002	-0.016	0.011	-0.016	0.022	0.018
Robust p-value	0.004**	0.909	0.083*	0.04**	0.199	0.226	0.095*
Robust conf. Int.	[0.004, 0.020]	[-0.029 , 0.032]	[-0.034 , 0.002]	[0.001 , 0.022]	[-0.040 , 0.008]	[-0.014 , 0.058]	[-0.003 , 0.040]
CCT-Optimal BW	32.23	32.23	32.23	32.23	32.23	32.23	32.23
Eff. Number Obs	2856	459	628	718	592	639	907
Mccray test (robust p-value)	0.1514	0.2688	0.271	0.1502	0.2484	0.3288	0.4564
Panel B: Quadratic Specification							
Rd Estimator	0.011	0.008	-0.016	0.014	-0.032	0.013	0.030
Robust p-value	0.035**	0.660	0.225	0.035**	0.025**	0.576	0.046**
Robust conf. Int.	[0.001, 0.021]	[-0.029 , 0.045]	[-0.041 , 0.010]	[0.001 , 0.027]	[-0.060 , -0.004]	[-0.034 , 0.061]	[-0.003 , 0.040]
CCT-Optimal BW	38.846	38.846	38.846	38.846	38.846	38.846	38.846
Eff. Number Obs	3508	562	781	883	725	793	1107
Mccray test (robust p-value)	0.1514	0.2688	0.271	0.1502	0.2484	0.3288	0.4564
Panel C: Cubic Specification							
Rd Estimator	0.009	0.012	-0.023	0.016	-0.036	0.011	0.030
Robust p-value	0.076*	0.551	0.164	0.049**	0.016**	0.666	0.081*
Robust conf. Int.	[-0.001, 0.020]	[-0.027 , 0.050]	[-0.057 , 0.010]	[0.000 , 0.032]	[-0.066 , -0.007]	[-0.039 , 0.061]	[-0.004 , 0.064]
CCT-Optimal BW	53.668	59.335	52.702	53.736	48.218	52.578	47.689
Eff. Number Obs	4729	793	781	1175	994	1074	1486
Mccray test (robust p-value)	0.1514	0.2688	0.271	0.1502	0.2484	0.3288	0.4564

Note: *** denotes significance at 1 percent, ** at 5 percent, and * at 10 percent level. Table 1 reports source RD estimates of the effect of schools in Ceará on the School Management Quality Index (SQMI), considering 2007 to 2017. Panel A shows the linear specification, Panel B the quadratic specification, and Panel C the cubic specification. Optimal bandwidths for all estimation are defined for the optimal bandwidths in 2011 to 2017 (11/17). We include weighted control variables. We report robust-bias corrected p-values. The estimation used control variables. By choice, the authors decided to omit the results. Standard errors are clustered by municipality.

Table A3.9 – GRD estimation point in 2011/2017

Point	RD Effect	Robust p-val	Robust conf. Int.	bandwidth	Number Obs
1	0.01	0.8	[-0.04 , 0.05]	116.9	1759
2	0	0.65	[-0.05 , 0.03]	112.5	1806
3	0.01	0.78	[-0.03 , 0.04]	91.5	1159
4	0	0.59	[-0.05 , 0.03]	90.4	1173
5	-0.04	0.01	[-0.08 , -0.01]	90.9	977
6	-0.01	0.27	[-0.06 , 0.02]	97.9	1024
7	0	0.88	[-0.02 , 0.02]	167.2	1319
8	-0.04	0.01	[-0.08 , -0.01]	94.7	756
9	-0.01	0.41	[-0.06 , 0.02]	92.9	785
10	0.01	0.53	[-0.02 , 0.04]	103.6	956
11	0.01	0.38	[-0.01 , 0.04]	124	1316
12	0.02	0.1	[0 , 0.04]	133.2	1523
13	0.03	0.01	[0.01 , 0.07]	110.2	1199
14	0.01	0.41	[-0.02 , 0.04]	92.5	951
15	-0.01	0.76	[-0.04 , 0.03]	94.7	834
16	0	0.8	[-0.03 , 0.04]	110.7	1054
17	-0.01	0.39	[-0.04 , 0.02]	96.3	1012
18	-0.02	0.15	[-0.04 , 0.01]	104.2	1637
19	0	0.72	[-0.03 , 0.04]	80.8	794
20	0.13	0.01	[0.04 , 0.24]	46.3	289
21	0.03	0.09	[0 , 0.07]	62	441
22	0.01	0.56	[-0.02 , 0.03]	99.7	1344
23	-0.02	0.06	[-0.07 , 0]	71.8	921
24	0.01	0.75	[-0.05 , 0.03]	59.2	719
25	0	0.73	[-0.05 , 0.03]	66.2	804
26	0	0.49	[-0.03 , 0.01]	142.5	2188
27	-0.01	0.59	[-0.05 , 0.03]	94	1203
28	0.01	0.66	[-0.03 , 0.05]	97.9	1148
29	0	0.89	[-0.05 , 0.04]	88.8	751
30	0.03	0.07	[0 , 0.06]	109.6	905
31	0.03	0.1	[-0.01 , 0.06]	110.7	856
32	0.02	0.56	[-0.03 , 0.05]	84.5	581
33	0.01	0.61	[-0.03 , 0.05]	83.8	545
34	0.03	0.18	[-0.01 , 0.08]	84.9	494
35	0.05	0.12	[-0.01 , 0.1]	81.3	363
36	0.03	0.32	[-0.02 , 0.08]	98.8	582
37	0.02	0.25	[-0.01 , 0.06]	149.4	1277
38	0.03	0.47	[-0.04 , 0.09]	105.6	551
39	0.07	0.12	[-0.02 , 0.18]	75.4	207
43	0	0.94	[-0.03 , 0.03]	169.5	1571
44	-0.02	0.2	[-0.07 , 0.01]	142	1014
45	-0.14	0	[-0.2 , -0.11]	66	271
48	0.12	0.07	[-0.01 , 0.27]	59.2	172
49	0.05	0.01	[0.01 , 0.08]	116.2	1426
50	0.04	0.04	[0 , 0.07]	118.4	1558
51	0.01	0.66	[-0.03 , 0.04]	107.3	1419
52	0	0.76	[-0.05 , 0.04]	94.3	1273
Mean Result					0.011
Mean Result with robust p-val <0.05					0.028

Table A3.10 – GRD estimation point in 2007

Point	RD Effect	Robust p-val	Robust conf. Int.	bandwidth	Number Obs
1	0.01	0.52	[-0.03 , 0.05]	123.2	294
2	0.01	0.37	[-0.01 , 0.04]	152.2	379
3	0.01	0.32	[-0.01 , 0.04]	155.4	374
4	0.01	0.22	[-0.01 , 0.04]	137	322
5	0.01	0.21	[-0.01 , 0.04]	151.3	327
6	0.01	0.18	[-0.01 , 0.04]	147.7	312
7	0.01	0.38	[-0.01 , 0.03]	149.1	207
8	0.01	0.25	[-0.01 , 0.02]	148.4	218
9	0.01	0.25	[-0.01 , 0.02]	145.4	220
10	0.01	0.47	[-0.01 , 0.02]	140	235
11	0	0.89	[-0.02 , 0.02]	125.1	228
12	0	0.95	[-0.03 , 0.03]	112.3	214
13	0	0.57	[-0.04 , 0.02]	86.5	138
14	0	0.68	[-0.03 , 0.02]	107.3	210
15	0.01	0.75	[-0.02 , 0.02]	115.8	234
16	0.01	0.3	[-0.01 , 0.03]	148.3	353
17	0.02	0.2	[-0.01 , 0.05]	167.3	485
18	0.01	0.34	[-0.01 , 0.02]	160.7	478
19	0	0.99	[-0.02 , 0.02]	126.1	340
20	-0.01	0.38	[-0.02 , 0.01]	121.7	289
21	-0.01	0.53	[-0.02 , 0.01]	134.7	323
22	-0.01	0.42	[-0.03 , 0.01]	148.8	418
23	-0.01	0.47	[-0.03 , 0.01]	168.3	474
24	-0.01	0.52	[-0.03 , 0.02]	164.3	452
25	-0.01	0.51	[-0.03 , 0.02]	158.6	427
26	0	0.67	[-0.03 , 0.02]	180.8	480
27	0	0.7	[-0.04 , 0.02]	193.3	487
28	-0.02	0.38	[-0.08 , 0.03]	127.5	255
29	-0.02	0.41	[-0.09 , 0.04]	151.8	329
30	-0.06	0.22	[-0.19 , 0.05]	123	189
31	-0.07	0.17	[-0.2 , 0.04]	130.4	175
32	-0.04	0.23	[-0.12 , 0.03]	166.9	336
33	-0.05	0.07	[-0.12 , 0]	118.7	193
36	-0.02	0.36	[-0.08 , 0.03]	106.7	118
37	-0.01	0.56	[-0.05 , 0.03]	107.8	109
50	0	0.92	[-0.04 , 0.03]	135	290
52	0.01	0.75	[-0.04 , 0.05]	123.9	286
Mean Result					-0.005
Mean Result with robust p-val <0.05					-

Table A3.11 – GRD estimation point in 2009

Point	RD Effect	Robust p-val	Robust conf. Int.	bandwidth	Number Obs
3	-0.06	0.33	[-0.18 , 0.06]	105.4	311
4	-0.03	0.7	[-0.14 , 0.09]	117.2	354
5	0	0.82	[-0.07 , 0.09]	109.7	245
7	0.01	0.45	[-0.02 , 0.04]	150	309
8	0.01	0.53	[-0.02 , 0.04]	106.6	219
9	0.01	0.23	[-0.01 , 0.05]	81.8	175
10	0.02	0.05	[0 , 0.06]	70.6	164
11	0.01	0.19	[-0.01 , 0.05]	82.5	200
12	0.02	0.19	[-0.01 , 0.05]	116.8	316
13	0.01	0.19	[-0.01 , 0.04]	163.9	484
14	0.01	0.71	[-0.02 , 0.03]	114.4	296
15	0.01	0.53	[-0.02 , 0.03]	84.7	166
16	0.01	0.58	[-0.02 , 0.04]	94	193
17	0.04	0.03	[0 , 0.08]	74.5	167
18	-0.01	0.18	[-0.04 , 0.01]	126.4	489
19	0.01	0.42	[-0.02 , 0.04]	102	337
20	-0.01	0.49	[-0.06 , 0.03]	114.1	308
21	-0.02	0.2	[-0.06 , 0.01]	126.9	352
22	-0.02	0.21	[-0.06 , 0.01]	112.3	334
23	0	0.83	[-0.03 , 0.04]	154.3	543
24	0.01	0.57	[-0.03 , 0.06]	130.6	439
28	0.01	0.64	[-0.03 , 0.05]	117.7	301
29	-0.04	0.01	[-0.08 , -0.01]	168.6	492
30	-0.1	0	[-0.16 , -0.05]	86.5	126
31	-0.1	0	[-0.17 , -0.06]	94.5	130
32	-0.09	0	[-0.15 , -0.05]	92.6	124
33	-0.1	0	[-0.18 , -0.05]	104.3	161
34	-0.1	0	[-0.18 , -0.05]	124.7	241
35	-0.1	0	[-0.17 , -0.04]	134.7	280
36	-0.09	0	[-0.15 , -0.04]	143.7	259
37	-0.09	0	[-0.15 , -0.03]	156.6	289
45	-0.07	0	[-0.12 , -0.03]	197.6	466
Mean Result					-0.026
Mean Result with robust p-val <0.05					-0.076

Table A3.12 – GRD estimation point in 2007/2009

Point	RD Effect	Robust p-val	Robust conf. Int.	bandwidth	Number Obs
1	-0.02	0.44	[-0.1 , 0.04]	133.1	737
2	-0.01	0.79	[-0.11 , 0.08]	130.8	770
3	0	0.95	[-0.08 , 0.08]	137.8	775
4	0.01	0.67	[-0.05 , 0.08]	156.4	862
5	0.02	0.33	[-0.02 , 0.06]	169.8	864
6	0.01	0.32	[-0.02 , 0.05]	207.2	925
7	0.02	0.13	[-0.01 , 0.07]	131.6	440
8	0.02	0.23	[-0.02 , 0.06]	102.6	340
9	0.01	0.36	[-0.02 , 0.06]	96	338
10	0.03	0.08	[0 , 0.07]	100.4	391
11	0.02	0.15	[-0.01 , 0.05]	133.8	627
12	0.02	0.23	[-0.01 , 0.04]	169.2	793
13	0.02	0.28	[-0.02 , 0.05]	134.6	669
14	0.01	0.84	[-0.04 , 0.05]	107.1	489
15	0.01	0.99	[-0.05 , 0.05]	90.3	327
16	0.02	0.47	[-0.02 , 0.05]	110.6	455
17	0.04	0	[0.02 , 0.09]	88.5	403
18	0	0.71	[-0.03 , 0.02]	131.2	900
19	0	0.99	[-0.03 , 0.03]	118.4	709
20	0.01	0.46	[-0.03 , 0.06]	120.4	619
21	0.01	0.47	[-0.02 , 0.05]	130.1	667
22	0.01	0.83	[-0.04 , 0.05]	123.7	704
23	0	0.95	[-0.04 , 0.04]	135.5	838
24	0.01	0.57	[-0.02 , 0.04]	165.9	1035
25	0.01	0.66	[-0.02 , 0.04]	178.6	1124
26	0.01	0.56	[-0.02 , 0.05]	134.3	764
27	0.01	0.5	[-0.03 , 0.05]	126.6	648
28	0	0.69	[-0.03 , 0.05]	130.8	617
29	-0.01	0.7	[-0.05 , 0.03]	159.5	778
30	-0.02	0.26	[-0.07 , 0.02]	183.7	909
31	-0.03	0.1	[-0.09 , 0.01]	186.3	853
32	-0.05	0.03	[-0.11 , -0.01]	140.4	561
33	-0.06	0.04	[-0.13 , 0]	112.9	350
34	-0.06	0.13	[-0.15 , 0.02]	115.5	357
35	-0.05	0.31	[-0.17 , 0.05]	107.4	295
36	-0.05	0.34	[-0.16 , 0.05]	103	243
37	-0.05	0.41	[-0.15 , 0.06]	98.7	206
38	-0.04	0.41	[-0.14 , 0.06]	111.7	242
39	-0.03	0.41	[-0.13 , 0.05]	166.2	567
40	-0.01	0.9	[-0.1 , 0.09]	175.5	619
41	0	0.88	[-0.11 , 0.13]	141	306
Mean Result					-0.006
Mean Result with robust p-val <0.05					-0.023

Table A3.13 – GRD estimation point in 2011

Point	RD Effect	Robust p-val	Robust conf. Int.	bandwidth	Number Obs
1	0	0.98	[-0.03 , 0.03]	108.7	414
2	0.01	0.5	[-0.03 , 0.05]	144.5	614
3	0	0.69	[-0.04 , 0.06]	139.1	574
4	0	0.9	[-0.05 , 0.05]	155.5	641
5	-0.01	0.68	[-0.04 , 0.03]	172.4	652
6	-0.02	0.27	[-0.05 , 0.01]	193.2	675
7	0.01	0.1	[0 , 0.03]	150.4	320
8	0.01	0.17	[-0.01 , 0.04]	111.5	247
9	0.02	0.18	[-0.01 , 0.06]	91.2	210
10	0.02	0.18	[-0.01 , 0.06]	87.5	209
11	0.05	0.02	[0.01 , 0.1]	75.7	193
12	0.07	0.05	[0 , 0.16]	74.6	166
13	0.04	0.15	[-0.01 , 0.1]	109.9	314
14	0.02	0.25	[-0.02 , 0.08]	109.4	299
15	0.01	0.21	[-0.01 , 0.05]	138	424
16	0.01	0.26	[-0.01 , 0.04]	125.3	351
17	0	0.89	[-0.02 , 0.02]	145	557
18	0	0.65	[-0.03 , 0.02]	112	440
19	0	0.89	[-0.02 , 0.03]	122.1	424
20	0.02	0.05	[0 , 0.04]	176.4	610
21	0.03	0.01	[0.01 , 0.06]	122.3	404
22	0.01	0.26	[-0.01 , 0.03]	144.4	554
23	0	0.91	[-0.02 , 0.02]	147.5	590
24	0	0.75	[-0.03 , 0.02]	136.8	531
25	0	0.96	[-0.03 , 0.03]	143.5	576
26	0	0.86	[-0.03 , 0.03]	129.9	489
27	0.01	0.37	[-0.02 , 0.04]	131.1	454
28	0.03	0.03	[0 , 0.06]	118.8	362
29	0.03	0.03	[0 , 0.06]	131.9	387
30	0.02	0.06	[0 , 0.05]	131.1	325
31	0.01	0.15	[-0.01 , 0.04]	160.6	439
32	0.01	0.56	[-0.02 , 0.03]	141.9	373
33	-0.01	0.6	[-0.03 , 0.02]	116.9	260
34	-0.02	0.24	[-0.05 , 0.01]	100	167
35	-0.02	0.28	[-0.06 , 0.02]	101.8	168
39	-0.06	0.22	[-0.17 , 0.04]	115.7	155
40	-0.02	0.65	[-0.09 , 0.06]	203	582
41	-0.01	0.97	[-0.08 , 0.07]	222.7	778
42	0.02	0.52	[-0.07 , 0.14]	158.5	304
43	0.02	0.5	[-0.07 , 0.14]	151.4	280
44	0.01	0.65	[-0.07 , 0.11]	166.3	393
45	0	0.9	[-0.09 , 0.1]	146.2	338
46	0	0.98	[-0.09 , 0.09]	144.1	398
47	0	0.98	[-0.06 , 0.06]	160.9	498
48	0.02	0.5	[-0.03 , 0.07]	94.4	187
50	0	0.98	[-0.04 , 0.04]	118.6	405
51	0	0.93	[-0.06 , 0.05]	101.3	352
52	-0.02	0.69	[-0.07 , 0.04]	95.3	339
Mean Result					0.007
Mean Result with robust p-val <0.05					0.023

Table A3.14 – GRD estimation point in 2013

Point	RD Effect	Robust p-val	Robust conf. Int.	bandwidth	Number Obs
1	0.05	0.45	[-0.07 , 0.15]	86	218
2	0.1	0.01	[0.03 , 0.21]	84.8	201
3	0.08	0.01	[0.02 , 0.17]	86.7	212
4	0.07	0.01	[0.02 , 0.14]	94.9	247
5	0.04	0.26	[-0.03 , 0.1]	124.1	326
6	0.04	0.17	[-0.01 , 0.07]	146.6	414
7	-0.02	0.34	[-0.08 , 0.03]	119.8	218
8	-0.03	0.21	[-0.1 , 0.02]	111.4	214
9	-0.01	0.52	[-0.1 , 0.05]	110.9	227
10	-0.01	0.64	[-0.08 , 0.05]	128.7	291
11	-0.01	0.64	[-0.08 , 0.05]	117.6	274
12	0	0.97	[-0.06 , 0.06]	117.3	283
13	0.02	0.27	[-0.03 , 0.09]	105.3	247
14	0.02	0.52	[-0.05 , 0.11]	98.2	224
15	0.01	0.69	[-0.07 , 0.11]	102.5	197
16	0.02	0.59	[-0.05 , 0.09]	103.6	200
17	-0.06	0.01	[-0.12 , -0.02]	113.2	272
18	-0.01	0.74	[-0.06 , 0.04]	122.8	392
19	0.03	0.11	[-0.01 , 0.09]	141.4	437
20	0.13	0.01	[0.04 , 0.25]	72.5	135
21	0.07	0	[0.03 , 0.13]	91.4	231
22	0.03	0.39	[-0.03 , 0.09]	103.1	295
23	0.01	0.76	[-0.04 , 0.06]	124.1	410
24	0.01	0.92	[-0.05 , 0.05]	120.9	393
25	0	0.95	[-0.05 , 0.05]	115.3	373
26	0.02	0.71	[-0.05 , 0.07]	98.3	309
27	0.02	0.73	[-0.06 , 0.09]	93.4	264
28	0	0.97	[-0.08 , 0.08]	103	281
29	0.01	0.91	[-0.08 , 0.09]	106.8	270
30	0.03	0.29	[-0.03 , 0.09]	116.8	233
31	0.04	0.09	[-0.01 , 0.1]	114.1	207
32	0.04	0.15	[-0.02 , 0.09]	108.4	201
33	0.03	0.38	[-0.04 , 0.09]	104	186
34	-0.01	0.66	[-0.08 , 0.05]	100.9	159
35	0.01	0.99	[-0.06 , 0.06]	142	358
44	-0.01	0.56	[-0.11 , 0.06]	152.9	248
48	0.1	0.14	[-0.03 , 0.23]	97.3	164
49	0.07	0.08	[-0.01 , 0.14]	115.4	276
50	0.05	0.25	[-0.03 , 0.11]	116.6	303
51	0.03	0.57	[-0.08 , 0.14]	96	240
Mean Result					0.025
Mean Result with robust p-val <0.05					0.065

Table A3.15 – GRD estimation point in 2015

Point	RD Effect	Robust p-val	Robust conf. Int.	bandwidth	Number Obs
1	0.01	0.95	[-0.18 , 0.17]	107.5	327
2	0.07	0.46	[-0.08 , 0.17]	82.3	198
3	0.02	0.93	[-0.1 , 0.09]	85.4	209
4	-0.05	0.12	[-0.15 , 0.02]	79.7	181
5	-0.08	0.01	[-0.17 , -0.02]	88.2	208
6	0	0.68	[-0.09 , 0.06]	117.2	298
7	-0.01	0.67	[-0.1 , 0.06]	106.1	174
8	-0.02	0.39	[-0.12 , 0.05]	100.7	173
9	-0.02	0.63	[-0.12 , 0.07]	105.6	191
10	0.01	0.81	[-0.06 , 0.08]	116.9	238
11	0.02	0.84	[-0.07 , 0.08]	114.4	251
12	0.02	0.41	[-0.03 , 0.08]	142.7	357
13	0.04	0.1	[-0.01 , 0.1]	134.1	354
14	0.03	0.38	[-0.05 , 0.13]	90.6	216
15	-0.05	0.35	[-0.18 , 0.06]	80.5	144
17	-0.01	0.69	[-0.07 , 0.04]	135.5	433
18	0	0.87	[-0.04 , 0.04]	147	515
19	0.02	0.23	[-0.02 , 0.07]	152.9	502
20	0.02	0.35	[-0.02 , 0.07]	113.9	333
21	0	0.9	[-0.04 , 0.05]	129.7	398
22	-0.01	0.5	[-0.05 , 0.03]	129.3	463
23	-0.01	0.57	[-0.07 , 0.04]	89.2	285
26	-0.04	0.28	[-0.14 , 0.04]	70.7	213
27	-0.02	0.62	[-0.12 , 0.07]	84.1	261
28	0.01	0.8	[-0.05 , 0.07]	150.8	468
29	0	0.97	[-0.08 , 0.07]	107.4	297
30	0.01	0.93	[-0.07 , 0.08]	106.2	214
32	0.03	0.76	[-0.07 , 0.1]	90.2	153
33	0.06	0.28	[-0.04 , 0.15]	91.8	151
34	0.11	0.02	[0.02 , 0.21]	84.3	115
36	0.14	0	[0.06 , 0.22]	95.2	121
37	0.13	0	[0.05 , 0.23]	101.6	136
38	0.15	0	[0.05 , 0.28]	106.1	132
42	0.03	0.24	[-0.02 , 0.09]	162.5	279
43	0.01	0.86	[-0.05 , 0.07]	137.8	186
49	0.04	0.28	[-0.03 , 0.12]	117.4	329
50	0.05	0.11	[-0.01 , 0.11]	147.6	445
52	-0.02	0.68	[-0.2 , 0.13]	97	280
Mean Result					0.018
Mean Result with robust p-val <0.05					0.090

Table A3.16 – GRD estimation point in 2017

Point	RD Effect	Robust p-val	Robust conf. Int.	bandwidth	Number Obs
2	0.03	0.67	[-0.07 , 0.1]	76.9	290
3	0	0.8	[-0.08 , 0.06]	86.3	351
4	-0.04	0.14	[-0.12 , 0.02]	93.6	390
5	-0.06	0.03	[-0.15 , -0.01]	92.7	319
6	-0.03	0.21	[-0.11 , 0.02]	113.9	412
7	-0.05	0.06	[-0.12 , 0]	107.9	225
8	-0.02	0.28	[-0.08 , 0.02]	129	348
9	0.01	0.87	[-0.04 , 0.05]	161.6	451
10	0.01	0.52	[-0.03 , 0.06]	171.1	495
11	0.02	0.4	[-0.02 , 0.06]	180.2	536
12	0.02	0.43	[-0.03 , 0.07]	143.5	488
13	0.01	0.69	[-0.04 , 0.06]	120.4	397
14	0.01	0.78	[-0.04 , 0.05]	150.6	574
15	0.01	0.75	[-0.04 , 0.05]	153.5	621
16	0	0.87	[-0.04 , 0.05]	152.1	621
17	-0.02	0.42	[-0.07 , 0.03]	104.2	377
18	-0.04	0.07	[-0.1 , 0]	95.8	469
19	0.04	0.03	[0 , 0.11]	102.9	485
20	0.24	0	[0.15 , 0.38]	65.3	159
21	0.1	0	[0.05 , 0.17]	80.6	273
22	-0.01	0.47	[-0.07 , 0.03]	102.6	433
23	-0.06	0.01	[-0.12 , -0.02]	110.4	498
24	-0.07	0	[-0.13 , -0.03]	110.6	503
27	-0.1	0.01	[-0.2 , -0.04]	68.7	181
28	0.01	0.79	[-0.07 , 0.09]	102	365
29	-0.01	0.65	[-0.11 , 0.07]	96.6	269
30	0.05	0.14	[-0.02 , 0.11]	118.9	317
31	0.04	0.31	[-0.03 , 0.11]	119.6	283
32	0.01	0.9	[-0.09 , 0.08]	91.8	193
33	0	0.86	[-0.11 , 0.09]	85.8	176
34	0.04	0.49	[-0.07 , 0.14]	103.9	251
35	0.06	0.29	[-0.05 , 0.17]	106.8	247
36	0.03	0.39	[-0.04 , 0.11]	144.1	425
37	0.03	0.3	[-0.03 , 0.11]	139.4	363
38	0.06	0.38	[-0.07 , 0.19]	91.1	145
44	-0.04	0.16	[-0.11 , 0.02]	161.8	518
49	0.05	0.18	[-0.03 , 0.13]	120.6	499
50	0.05	0.23	[-0.03 , 0.11]	120.5	528
51	-0.01	0.67	[-0.09 , 0.06]	95.6	409
Mean Result					0.009
Mean Result with robust p-val <0.05					0.013

Table A3.17 – RDD estimation - Mechanism Results for Linear specification with outcomes in 2011

	School enrollment	Teachers	Teachers with Postgraduate Education	Classes per Teacher	Age - grade distortion - 1 to 9 grade	Age - grade distortion - 1 to 5 grade	Age - grade distortion - 6 to 9 grade
Panel A: 1^{Q} tertile							
Rd Estimator	0.013	0.004	0.011	0.031	0.018	0.023	0.007
Robust p-value	0.148	0.686	0.296	0.200	0.114	0.015**	0.333
Robust conf. Int.	[-0.005 , 0.03]	[-0.016 , 0.025]	[-0.01 , 0.033]	[-0.016 , 0.078]	[-0.004 , 0.041]	[0.005 , 0.042]	[-0.007 , 0.021]
CCT-Optimal BW	31.930	32.023	54.487	28.558	29.081	32.487	45.355
Eff. Number Obs	170	201	297	120	171	206	296
Mccray test (robust p.value)	0.5172	0.2141	0.3227	0.7724	0.3038	0.388	0.6181
Panel B: 2^{Q} tertile							
Rd Estimator	0.003	0.000	0.009	-0.002	-0.002	0.014	0.019
Robust p-value	0.848	0.978	0.537	0.857	0.835	0.177	0.151
Robust conf. Int.	[-0.026 , 0.032]	[-0.032 , 0.031]	[-0.019 , 0.036]	[-0.023 , 0.019]	[-0.022 , 0.018]	[-0.006 , 0.034]	[-0.007 , 0.045]
CCT-Optimal BW	36.316	42.008	36.549	50.120	36.678	41.060	43.706
Eff. Number Obs	287	294	256	370	286	246	248
Mccray test (robust p.value)	0.8405	0.4836	0.3492	0.2316	0.5598	0.4281	0.5227
Panel C: 3^{Q} tertile							
Rd Estimator	0.018	0.021	0.009	0.011	0.013	-0.003	-0.021
Robust p-value	0.114	0.011**	0.349	0.205	0.587	0.868	0.350
Robust conf. Int.	[-0.004 , 0.041]	[0.005 , 0.036]	[-0.01 , 0.028]	[-0.006 , 0.029]	[-0.033 , 0.058]	[-0.045 , 0.038]	[-0.066 , 0.023]
CCT-Optimal BW	20.389	25.443	34.265	47.592	34.897	33.231	40.687
Eff. Number Obs	70	102	195	334	152	152	108
Mccray test (robust p.value)	0.6097	0.9164	0.4811	0.4253	0.1382	0.1365	0.141

Note: *** denotes significance at 1 percent, ** at 5 percent, and * at 10 percent level. Table 7 reports source RD estimates of the effect of schools in Ceará on the School Management Quality Index (SQMI), considering 2011. Panel A shows the linear specification, Panel B the quadratic specification, and Panel C the cubic specification. Optimal bandwidths following (CALONICO *et al.*, 2014). We include weighted control variables. We report robust-bias corrected p-values. The estimation used control variables. By choice, the authors decided to omit the results. Standard errors are clustered by municipality.

Table A3.18 – RDD estimation - Mechanism Results for Linear specification with outcomes in 2013

	School enrollment	Teachers	Teachers with Postgraduate Education	Classes per Teacher	Age - grade distortion - 1 to 9 grade	Age - grade distortion - 1 to 5 grade	Age - grade distortion - 6 to 9 grade
Panel A: 1^{Q} tertile							
Rd Estimator	0.009	-0.004	0.002	-0.072	-0.014	-0.031	-0.028
Robust p-value	0.783	0.893	0.943	0.063*	0.656	0.290	0.220
Robust conf. Int.	[-0.052 , 0.069]	[-0.058 , 0.051]	[-0.041 , 0.045]	[-0.148 , 0.004]	[-0.077 , 0.048]	[-0.088 , 0.026]	[-0.073 , 0.017]
CCT-Optimal BW	30.330	31.014	39.789	16.291	23.534	22.592	20.412
Eff. Number Obs	130	165	176	41	99	96	90
Mccray test (robust p.value)	0.6097	0.9164	0.4811	0.4253	0.1382	0.1365	0.141
Panel B: 2^{Q} tertile							
Rd Estimator	-0.012	-0.009	0.002	-0.019	-0.047	-0.043	-0.021
Robust p-value	0.580	0.679	0.917	0.526	0.099*	0.233	0.329
Robust conf. Int.	[-0.054 , 0.03]	[-0.052 , 0.034]	[-0.035 , 0.038]	[-0.077 , 0.039]	[-0.102 , 0.009]	[-0.114 , 0.028]	[-0.064 , 0.022]
CCT-Optimal BW	25.172	37.049	42.456	29.897	18.494	22.118	31.848
Eff. Number Obs	139	212	236	170	76	77	137
Mccray test (robust p.value)	0.6159	0.7573	0.2324	0.157	0.9879	0.9189	0.5671
Panel C: 3^{Q} tertile							
Rd Estimator	-0.029	0.004	-0.048	-0.016	0.008	0.046	0.011
Robust p-value	0.195	0.824	0.004***	0.346	0.753	0.079*	0.724
Robust conf. Int.	[-0.073 , 0.015]	[-0.035 , 0.044]	[-0.08 , -0.015]	[-0.051 , 0.018]	[-0.043 , 0.06]	[-0.005 , 0.097]	[-0.05 , 0.072]
CCT-Optimal BW	31.327	32.247	19.698	32.564	34.786	33.579	42.643
Eff. Number Obs	127	135	75	185	140	141	102
Mccray test (robust p.value)	0.765	0.9514	0.7252	0.3823	0.7177	0.7162	0.7842

Note: *** denotes significance at 1 percent, ** at 5 percent, and * at 10 percent level. Table 7 reports source RD estimates of the effect of schools in Ceará on the School Management Quality Index (SQMI), considering 2013. Panel A shows the linear specification, Panel B the quadratic specification, and Panel C the cubic specification. Optimal bandwidths following (CALONICO *et al.*, 2014). We include weighted control variables. We report robust-bias corrected p-values. The estimation used control variables. By choice, the authors decided to omit the results. Standard errors are clustered by municipality.

Table A3.19 – RDD estimation - Mechanism Results for Linear specification with outcomes in 2015

	School enrollment	Teachers	Teachers with Postgraduate Education	Classes per Teacher	Age - grade distortion - 1 to 9 grade	Age - grade distortion - 1 to 5 grade	Age - grade distortion - 6 to 9 grade
Panel A: 1^{Q} tertile							
Rd Estimator	0.031	0.024	-0.027	0.049	0.051	0.029	0.023
Robust p-value	0.514	0.560	0.361	0.304	0.130	0.322	0.450
Robust conf. Int.	[-0.062 , 0.123]	[-0.057 , 0.105]	[-0.085 , 0.031]	[-0.045 , 0.143]	[-0.015 , 0.117]	[-0.028 , 0.085]	[-0.036 , 0.081]
CCT-Optimal BW	41.167	35.255	31.969	30.945	28.668	26.548	23.849
Eff. Number Obs	203	189	146	110	143	123	107
Mccray test (robust p.value)	0.7444	0.3677	0.4192	0.8751	0.816	0.5147	0.372
Panel B: 2^{Q} tertile							
Rd Estimator	0.039	0.041	0.054	0.039	-0.007	0.019	0.006
Robust p-value	0.111	0.091*	0.084*	0.266	0.839	0.599	0.878
Robust conf. Int.	[-0.009 , 0.086]	[-0.007 , 0.089]	[-0.007 , 0.115]	[-0.03 , 0.108]	[-0.075 , 0.061]	[-0.053 , 0.091]	[-0.066 , 0.077]
CCT-Optimal BW	215	233	266	248	261	254	243
Eff. Number Obs	139	212	236	170	76	77	137
Mccray test (robust p.value)	0.9149	0.4761	0.3705	0.1156	0.9337	0.9211	0.676
Panel C: 3^{Q} tertile							
Rd Estimator	0.074	0.056	0.078	0.058	0.077	0.062	0.080
Robust p-value	0.026**	0.022**	0.007***	0.009***	0.012**	0.05*	0.062*
Robust conf. Int.	[0.009 , 0.14]	[0.008 , 0.103]	[0.022 , 0.134]	[0.015 , 0.102]	[0.017 , 0.138]	[0 , 0.124]	[-0.004 , 0.164]
CCT-Optimal BW	30.625	39.122	31.132	28.196	35.180	32.156	40.211
Eff. Number Obs	137	187	153	160	145	149	100
Mccray test (robust p.value)	0.5946	0.9349	0.3854	0.4399	0.2061	0.4186	0.1873

Note: *** denotes significance at 1 percent, ** at 5 percent, and * at 10 percent level. Table 7 reports source RD estimates of the effect of schools in Ceará on the School Management Quality Index (SQMI), considering 2015. Panel A shows the linear specification, Panel B the quadratic specification, and Panel C the cubic specification. Optimal bandwidths following (CALONICO *et al.*, 2014). We include weighted control variables. We report robust-bias corrected p-values. The estimation used control variables. By choice, the authors decided to omit the results. Standard errors are clustered by municipality.

Table A3.20 – RDD estimation - Mechanism Results for Linear specification with outcomes in 2017

	School enrollment	Teachers	Teachers with Postgraduate Education	Classes per Teacher	Age - grade distortion - 1 to 9 grade	Age - grade distortion - 1 to 5 grade	Age - grade distortion - 6 to 9 grade
Panel A: 1^{Q} tertile							
Rd Estimator	0.053	0.016	0.014	0.032	0.007	0.021	0.009
Robust p-value	0.095*	0.540	0.502	0.463	0.780	0.515	0.753
Robust conf. Int.	[-0.009 , 0.116]	[-0.034 , 0.066]	[-0.028 , 0.056]	[-0.053 , 0.117]	[-0.04 , 0.053]	[-0.043 , 0.085]	[-0.045 , 0.062]
CCT-Optimal BW	24.938	42.272	35.476	34.297	34.815	31.905	40.588
Eff. Number Obs	160	331	218	153	233	198	283
Mccray test (robust p.value)	0.4956	0.2551	0.22	0.7474	0.2476	0.1816	0.7419
Panel B: 2^{Q} tertile							
Rd Estimator	0.038	0.053	0.044	0.024	0.029	0.059	0.043
Robust p-value	0.097*	0.087*	0.097*	0.336	0.274	0.093	0.103
Robust conf. Int.	[-0.007 , 0.083]	[-0.008 , 0.113]	[-0.008 , 0.097]	[-0.025 , 0.073]	[-0.023 , 0.082]	[-0.01 , 0.128]	[-0.009 , 0.094]
CCT-Optimal BW	29.497	25.578	29.392	43.913	31.253	29.080	28.621
Eff. Number Obs	210	141	199	362	238	182	155
Mccray test (robust p.value)	0.6204	0.6166	0.1668	0.2083	0.8886	0.3827	0.2314
Panel C: 3^{Q} tertile							
Rd Estimator	0.024	0.044	0.033	0.014	0.070	0.048	0.106
Robust p-value	0.391	0.058*	0.267	0.445	0.011**	0.077*	0.016**
Robust conf. Int.	[-0.03 , 0.078]	[-0.002 , 0.09]	[-0.026 , 0.092]	[-0.022 , 0.05]	[0.016 , 0.123]	[-0.005 , 0.101]	[0.019 , 0.192]
CCT-Optimal BW	38.547	30.583	30.940	40.215	28.275	35.159	21.613
Eff. Number Obs	184	139	180	281	136	184	55
Mccray test (robust p.value)	0.7367	0.7811	0.4591	0.1793	0.4763	0.693	0.5919

Note: *** denotes significance at 1 percent, ** at 5 percent, and * at 10 percent level. Table 7 reports source RD estimates of the effect of schools in Ceará on the School Management Quality Index (SQMI), considering 2017. Panel A shows the linear specification, Panel B the quadratic specification, and Panel C the cubic specification. Optimal bandwidths following (CALONICO *et al.*, 2014). We include weighted control variables. We report robust-bias corrected p-values. The estimation used control variables. By choice, the authors decided to omit the results. Standard errors are clustered by municipality.

Table A3.21 – Variables from SAEB used to estimate the SMQI

SMQI questions	Answer	SAEB question
1) Standardization of Instructional Processes		
a) How structured or standardized are the instructional planning processes across the school?	Teacher	In your perception, the possible learning problems of students in the evaluated grade(s) or year(s) occur in this school due to Non-compliance with the curricular contents throughout the student's school trajectory.
	Teacher	In your perception, the possible learning problems of students in the evaluated grade(s) or year(s) occur in this school due to Teachers' workload, making planning and preparation difficult for classes.
	Teacher	How much of the predicted content were you able to develop with the students in this class this year?
b) What tools and resources are provided to teachers(e.g., standards-based lesson plan and textbooks) to ensure consistent level of quality in delivery across classroom	Principal	How did you choose the textbook this year?
	Teacher	Do students in this class have textbooks?

Table A3.21 – Variables from SAEB used to estimate the SMQI

SMQI questions	Answer	SAEB question
	Teacher	We would like to know which resources you use for teaching purposes in this class: Newspapers and informative magazines.
	Teacher	We would like to know what resources you use for teaching purposes in this class: Literature books.
	Teacher	We would like to know which resources you use for teaching purposes in this class: Copy machine (Xerox).
d) How does the school leader monitor and ensure consistency in quality across the classroom	Teacher	In this school and this year, indicate how often: The principal pays special attention to aspects related to student learning.
2) Personalizing of Instructions and Learning		
a) How often does the school identify individual students' needs? How are these needs accommodated within the classroom?	Teacher	In your perception, the possible learning problems of the students of the grade(s) or year(s) evaluated occur in this school due to the following: Curriculum contents are inadequate to the needs of the students.

Table A3.21 – Variables from SAEB used to estimate the SMQI

SMQI questions	Answer	SAEB question
c) What about students? How does the school ensure they are engaged in their own learning? How are parents incorporated in this process?	Principal	Indicate how often the following activities are carried out to minimize student absences this year and at this school: Teachers talk to students to solve the problem.
	Principal	Indicate how often the following activities are carried out to minimize student absences this year and at this school: Parents/-guardians are notified by communication from the school
	Principal	Indicate how often the following activities are carried out to minimize student absences this year and at this school: Parents/-guardians are called to the school to discuss the matter in a parent meeting.
	Principal	Indicate how often the following activities are carried out to minimize student absences this year and at this school: Parents/guardians are called to the school to talk about the matter individually.

Table A3.21 – Variables from SAEB used to estimate the SMQI

SMQI questions	Answer	SAEB question
	Principal	Indicate how often the following activities are carried out to minimize student absences this year and at this school: The school sends someone to the student's home.
	Teacher	In your perception, the possible learning problems of students in the evaluated grade(s) or year(s) occur at this school due to parents' lack of assistance and monitoring during the student's school life.
	Teacher	In your perception, the possible learning problems of students in the grade(s) or year(s) evaluated occur at this school due to: Disinterest and lack of effort on the part of the student.
	Teacher	In your perception, the possible learning problems of students in the grade(s) or year(s) assessed occur at this school due to the high rate of absences by students.
4) Adopting educational best practices		
a) How does the school encourage incorporating new teaching practices into the classroom	Principal	How many teachers at this school participated in the continuing education activities you organized in the last two years?

Table A3.21 – Variables from SAEB used to estimate the SMQI

SMQI questions	Answer	SAEB question
	Teacher	In this school and this year, indicate how often: The principal encourages innovative activities.
c) How does the school ensure that teachers use these new practices in the classroom? How often does this happen	Teacher	In this school and this year, indicate how often: The principal pays special attention to aspects related to student learning.
7) Performance Review		
a) How often do you review (school) performance- formally or informally - with teachers and staff	Principal	The Class Council comprises all teachers in each class/grade. How many times did the Class Council meet this year and in this school?
	Teacher	The Class Council comprises all teachers in each class/grade. How many times did the Class Council meet this year and in this school?
17) Promoting High Performers		
b) How do you identify and develop your star performers?	Teacher	In your perception, the possible learning problems of students in the evaluated grade(s) or year(s) occur in this school due to Teacher dissatisfaction and discouragement with the teaching career.

Table A3.21 – Variables from SAEB used to estimate the SMQI

SMQI questions	Answer	SAEB question
	Principal	In the last two years, have you organized any continuing education activities (updating, training, qualification, etc.) at this school?
18) Managing Talent		
b) How do you ensure you have enough teachers of the right type in the school?	Principal	This year, what was the main criterion for assigning classes to teachers?
20) Attracting Talent/ Creating a Distinctive Employee Value Proposition		
a) What makes it distinctive to teach at your school, unlike other similar schools? If you were to ask the last three candidates, would they agree? Why?	Teacher	This school year and this year indicate how often the principal encourages and motivates me to work.
	Teacher	In this school and this year, indicate how often I feel respected by the principal.
	Teacher	This school and this year indicate how often I have confidence in the principal as a professional.
	Teacher	In this school and this year, indicate how often I participate in decisions related to my work.

Table A3.21 – Variables from SAEB used to estimate the SMQI

SMQI questions	Answer	SAEB question
	Teacher	At this school and this year, please indicate how often The teaching staff considers my ideas.

APPENDIX B – CHAPTER 3

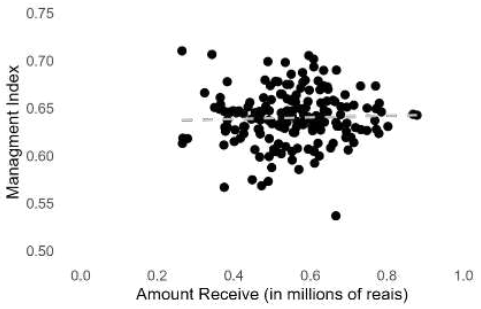
B1 - Assignment Mechanism

Using the SMQI in 2007 (pre-reform) and recovering the value transferred to the municipalities based on the educational results in the first year of the reform change (2009), We find that on average, a municipality above the median in the management index receives an amount of R$210,242.80, reais more than a municipality below the median, and a municipality in the 4º quartile in the management index receives, on average, an amount of R$ 382,262.50 reais more than a municipality in the 1º quartile in the management index.

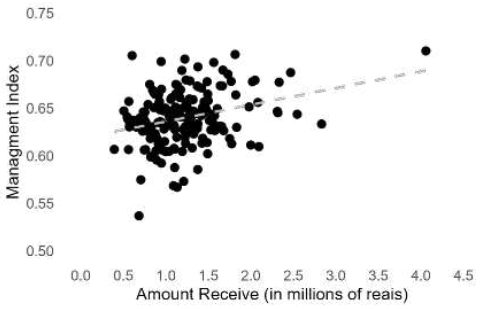
Using an OLS model to regress the management index in 2007 against the amount received because of the ICMS-Law in Ceara in 2007, 2009, and 2011, we show that before the reformulation of the ICMS law, the management index had a null effect on the amount received. After that, the management index had a positive and significant result in the amount received. Figure B1.1 shows a scatter plot of management index versus the amount received in educational results of the ICMS law in Ceará, figure (B1.1a) shows the result of the amount received in 2007, figure (B1.1b) show the result in the first year of the new amount received because of the new law, figure (B1.1c) show the result in the first year that kids who were assisted for the technical assistance program since the literacy done the 5th grade test, that counts for the amount distributed.

Figure B1.1 – Management Index versus amount Receive in Educational Results of the ICMS Law in Ceará

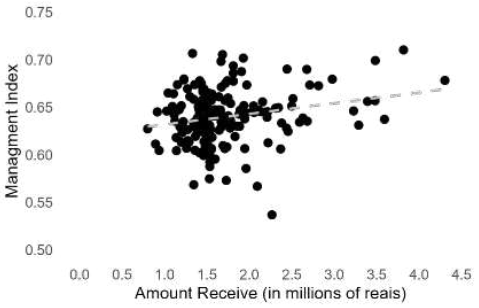
(a) Management Index (2007) versus amount receive (2007)



(b) Management Index (2007) versus amount receive (2009)



(c) Management Index (2007) versus amount receive (2011)

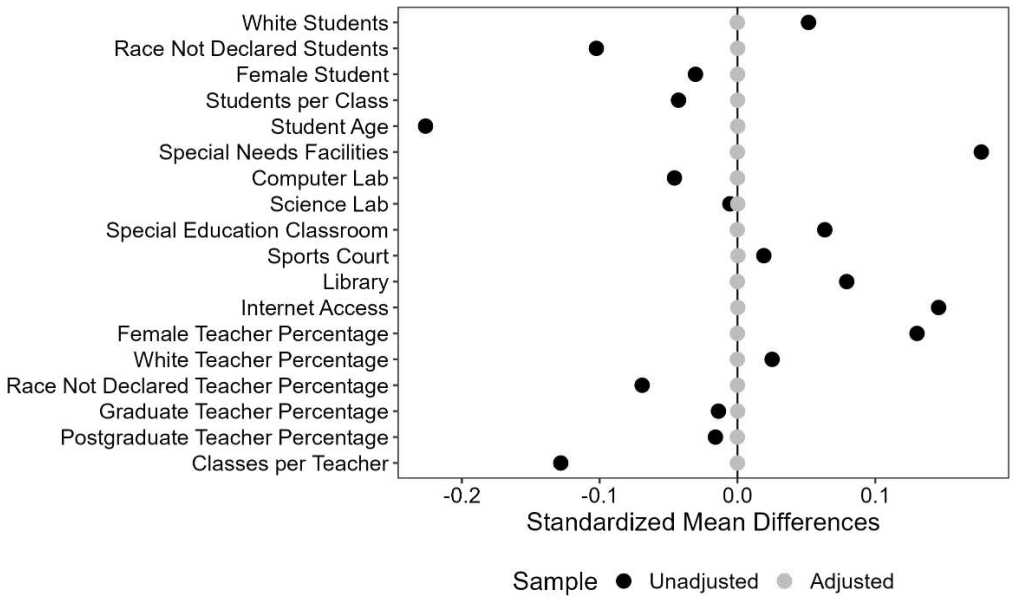


Note: The criteria between 1996 and 2007 were that 12.5% of the discretionary ICMS transfer should be divided as follows: Relationship between the sum of expenses incurred by the Municipality in the maintenance and development of education and the municipal revenue from taxes and federal and state constitutional transfers. The regression using the amount received in 2007 as a dependent variable and the index of 2007 as an independent variable has a null result. The criteria of aumont sharing after 2008 were that 18% based on the municipal rate of educational quality - IQE, based on indicators of the level and progress in the quality of the initial cycle of Basic Education. The regression using the amount received in 2009 and 2011 as a dependent variable and the index of 2007 as an independent variable has a positive and significant result for the amount received.

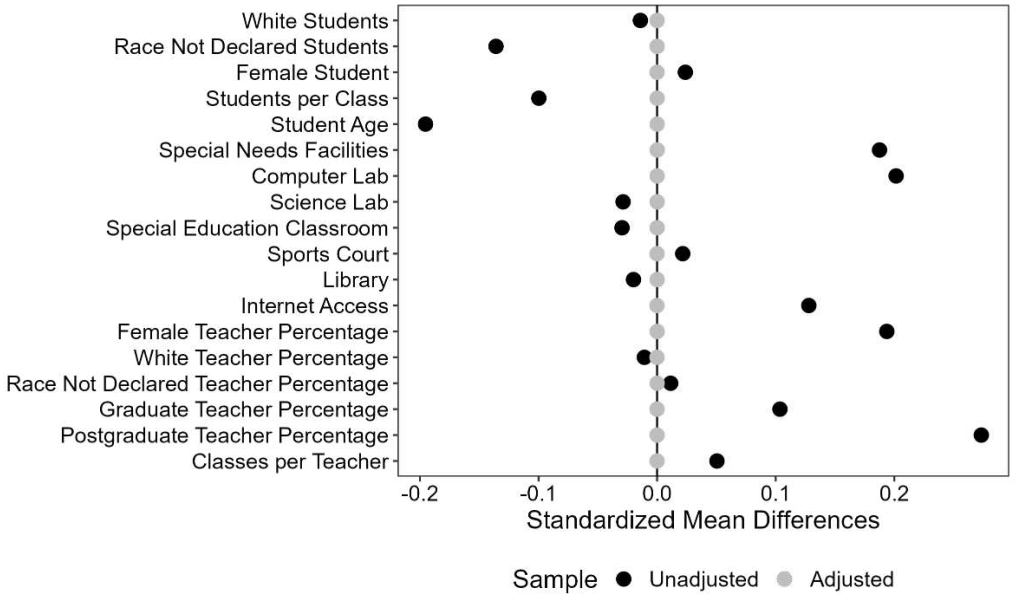
B2 - Additional figures

Figure B2.1 – Covariate Balance for estimation

(a) Covariate Balance for 5th grade

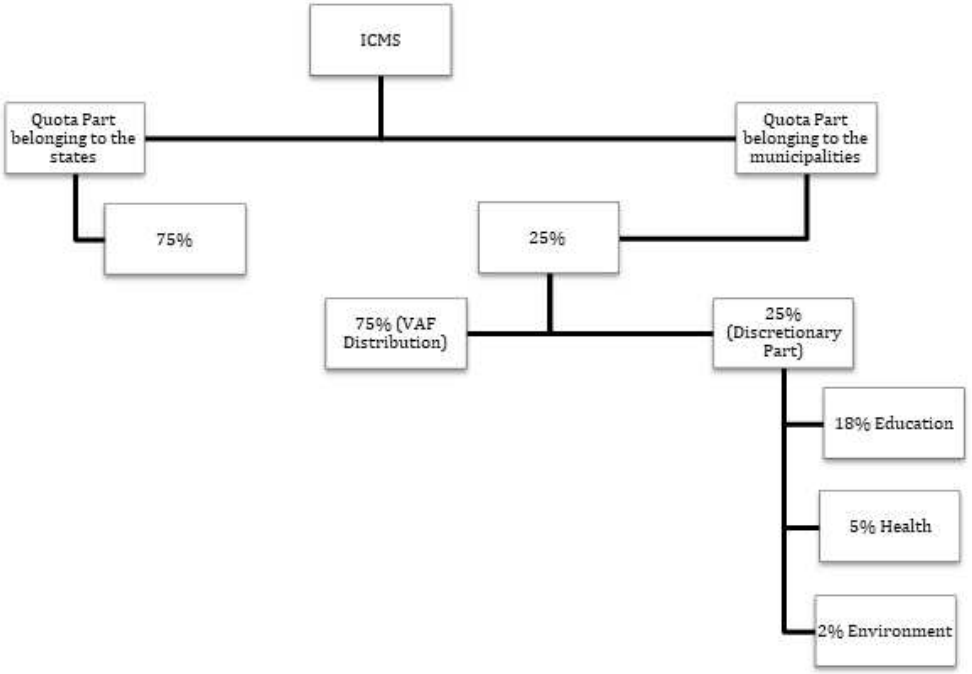


(b) Covariate Balance for 9th grade



Note: Figure B2.1 illustrates the covariate entropy balance proposed by Hainmueller (2012) before and after adjustment. Specifically, Figure B2.1a presents the adjustments made to estimate 5th-grade covariates, while Figure B2.1b shows the adjustments for estimating 9th-grade covariates.

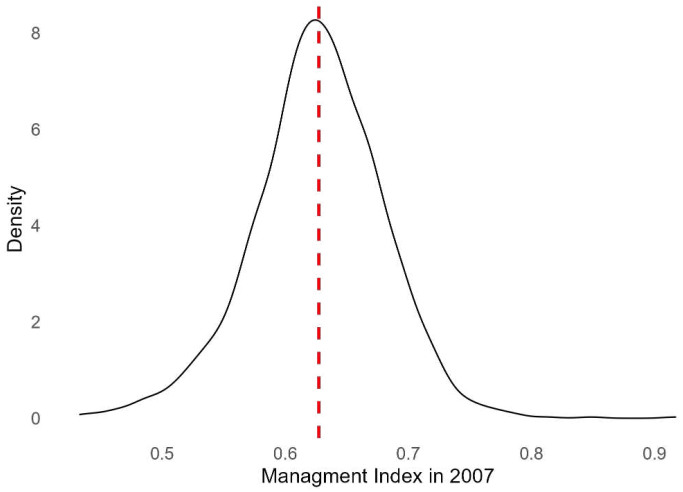
Figure B2.2 – ICMS transfer structure



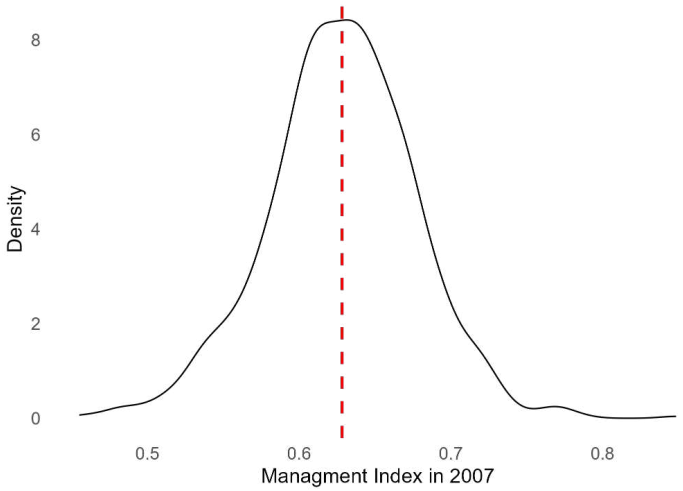
Note: Figure B2.2 outlines the new distribution of Quota-Part in Ceará municipalities after 2007. In December of 2007, the Law nº. 14,023, regulated in 2008, and became effective in 2009. From the 25% of the total state ICMS's revenue, 72% is destined based on municipal educational results, 20% for health outcomes, and 8% for environmental performance. That program of intergovernmental transfer replaced the previous criterion based on the size of the municipality.

Figure B2.3 – Distribuiton of SQMI in 2007

(a) Schools in Primary Grades



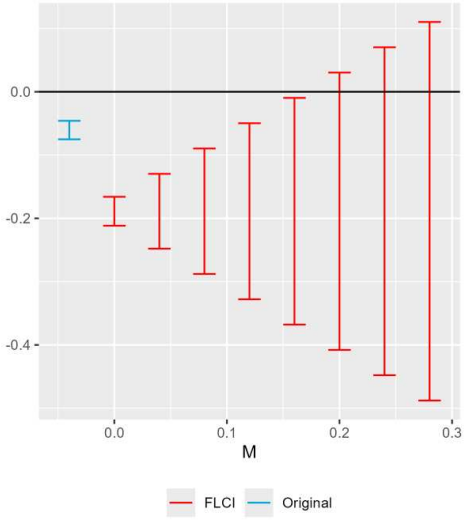
(b) Schools in Lower Secondary Grades



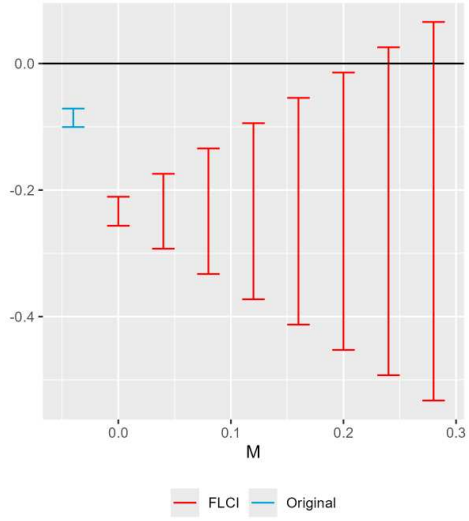
Note: Figure B2.3 illustrates the distribution of SQMI in 2007. Specifically, Figure B2.3a presents the distribution for primary schools, while Figure B2.3b shows the distribution for lower secondary schools The red dot line represents the median of the distribution.

Figure B2.4 – Parallel Trends - Sensitive Analysis for $\theta = \tau_5$ using $\Delta = \Delta^{SD}(M)$

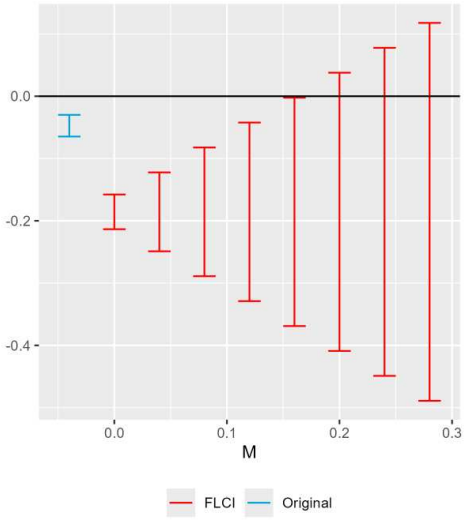
(a) Language 5th grade



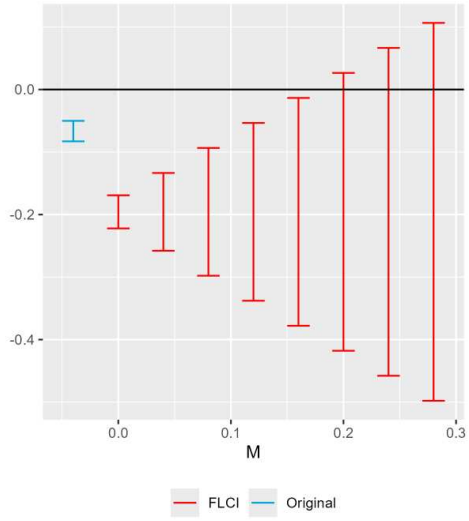
(b) Mathematics 5th grade



(c) Language 9th grade



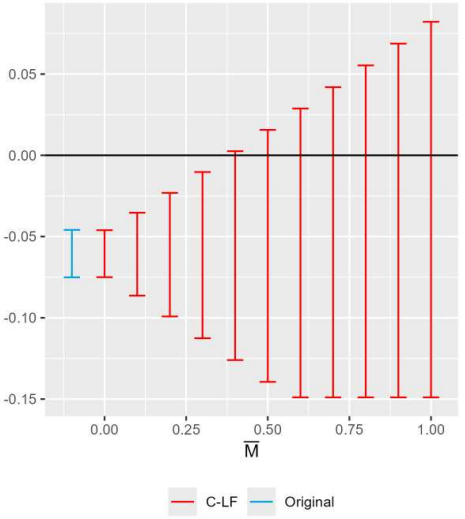
(d) Mathematics 9th grade



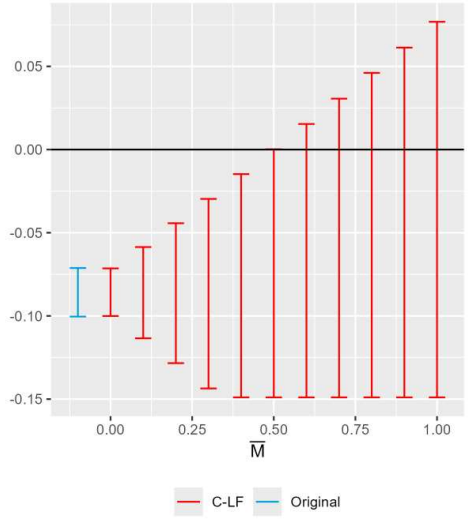
Note: The figure presents the "smoothing limits" for each estimation that we realize. This approach mainly expresses that the degree of violation after treatment does not deviate too much from the linear extrapolation trend before treatment. Under these results, we chose a violation level of 0.17 times the standard error, i.e., Mbar, in Language for 5th grade; 0.22 times the standard error in Mathematics for 5th grade; 0.17 times the standard error in Language for 5th grade and 0.18 times the standard error in Mathematics for 9th grade

Figure B2.5 – Parallel Trends - Relative Magnitudes Restrictions

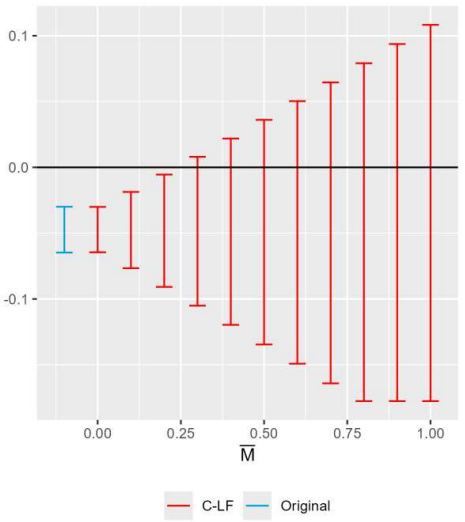
(a) Language 5th grade



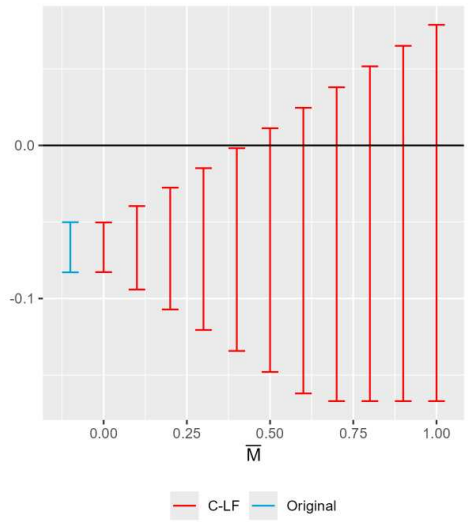
(b) Mathematics 5th grade



(c) Language 9th grade



(d) Mathematics 9th grade



Note: The figure presents the "breakdown value" for a significant effect is M = 0.4 in language for 5th grade; M =0.5 in Mathematics for 5th grade; M = 0.3 in language for 9th grade and M = 0.5 in mathematics for 9th grade, meaning that the significant result is robust to allowing for violations of parallel trends up to 1/3 to half as the max violation in pre-treatment period

B3 - Additional tables

Table B3.1 – Data Description: Baseline Covariates

Variable	Description	Source
White Students	Dummy indicating if the student identified as white in 2007	SAEB
Race Not Declared Students	Dummy indicating if the student did not declare their race in 2007	SAEB
Female Student	Dummy indicating if the student who took the test was female in 2007	SAEB
Age	Age of the student who took the test for each grade in 2007	SAEB
Students per Class	Average number of students per class in each school in 2007	School Census
Special Needs Facilities	Dummy indicating if the school's facilities and pathways were adequate for students with disabilities or reduced mobility in 2007	School Census
Computer Lab	Dummy indicating if the school had a computer lab in 2007	School Census
Science Lab	Dummy indicating if the school had a science lab in 2007	School Census
Special Education Classroom	Dummy indicating if the school had a specific room for Specialized Educational Assistance in 2007	School Census
Sports Court	Dummy indicating if the school had a sports court in 2007	School Census
Library	Dummy indicating if the school had a library/reading room in 2007	School Census
Internet Access	Dummy indicating if the school had internet access in 2007	School Census
Female Teacher Percentage	Percentage of female teachers per school in 2007	School Census
White Teacher Percentage	Percentage of teachers who identified as white per school in 2007	School Census
Race Not Declared Teacher Percentage	Percentage of teachers who did not declare their race per school in 2007	School Census
Graduate Teacher Percentage	Percentage of teachers with graduate degrees per school in 2007	School Census
Postgraduate Teacher Percentage	Percentage of teachers with postgraduate degrees per school in 2007	School Census
Classes per Teacher	Average number of classes each teacher had to teach in the school in 2007	School Census

Notes: SAEB variables are at the student level, while Census variables are at the school level.

Table B3.2 – Proficiency Results for 5th and 9th grade

PANEL A: Students in 5th grade										
	Mathematics					Language				
	07/09	07/11	07/13	07/15	07/17	07/09	07/11	07/13	07/15	07/17
DDD	0.001	0.073***	0.073***	0.103***	0.077***	0.005	0.032**	0.056***	0.090***	0.048***
	(0.014)	(0.014)	(0.016)	(0.015)	(0.015)	(0.014)	(0.015)	(0.015)	(0.015)	(0.016)
$Prog_{st=2007}$	0.022***	0.032***	0.029***	0.038***	0.037***	0.033***	0.035***	0.040***	0.036***	0.045***
	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)
$d_{09t} : Prog_{st=2007}$	0.025***	-0.008	0.004	-0.016*	0.008	0.008	-0.008	-0.009	-0.020**	0.010
	(0.009)	(0.009)	(0.010)	(0.009)	(0.009)	(0.009)	(0.009)	(0.010)	(0.009)	(0.010)
$d_{09t} : S_m$	0.058***	0.189***	0.181***	0.253***	0.330***	0.074***	0.170***	0.192***	0.278***	0.344***
	(0.010)	(0.010)	(0.011)	(0.010)	(0.011)	(0.010)	(0.010)	(0.011)	(0.011)	(0.011)
$Prog_{st=2007} : S_m$	0.009	-0.032***	-0.026**	-0.046***	-0.033***	0.008	-0.020*	-0.026**	-0.025**	-0.021
	(0.012)	(0.012)	(0.013)	(0.012)	(0.012)	(0.012)	(0.012)	(0.013)	(0.013)	(0.013)
Obs	160785	157955	158316	159150	160898	160785	157955	158316	159150	160898
R2 Adj.	0.092	0.126	0.122	0.219	0.252	0.082	0.111	0.132	0.241	0.283
Controls	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Year + Municipality F.E	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Municipality Cluster	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
PANEL B: Students in 9 th grade										
	Mathematics					Language				
	07/09	07/11	07/13	07/15	07/17	07/09	07/11	07/13	07/15	07/17
DDD	0.022	0.027	0.016	0.080***	0.082***	0.026	0.026	0.022	0.025	0.100***
	(0.017)	(0.018)	(0.018)	(0.017)	(0.019)	(0.018)	(0.018)	(0.018)	(0.019)	(0.019)
$Prog_{st=2007}$	-0.018	-0.037***	-0.009	0.024**	0.030**	-0.028**	-0.047***	-0.017	0.005	0.013
	(0.011)	(0.012)	(0.012)	(0.012)	(0.013)	(0.012)	(0.012)	(0.013)	(0.013)	(0.013)
$d_{09t} : Prog_{st=2007}$	0.027**	0.015	0.003	-0.014	0.010	0.030**	0.016	-0.001	0.022*	0.012
	(0.011)	(0.012)	(0.012)	(0.012)	(0.013)	(0.012)	(0.012)	(0.012)	(0.012)	(0.013)
$d_{09t} : S_m$	0.029**	0.094***	0.162***	0.159***	0.175***	0.058***	0.111***	0.172***	0.229***	0.185***
	(0.012)	(0.012)	(0.013)	(0.012)	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)	(0.014)
$Prog_{st=2007} : S_m$	-0.007	-0.006	-0.029*	-0.068***	-0.073***	0.000	0.007	-0.020	-0.062***	-0.048***
	(0.016)	(0.016)	(0.016)	(0.016)	(0.017)	(0.017)	(0.017)	(0.017)	(0.017)	(0.017)
Obs	118097	116724	116465	115530	115798	118097	116724	116465	115530	115798
R2 Adj.	0.081	0.091	0.089	0.130	0.152	0.095	0.097	0.110	0.170	0.229
Controls	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Year + Municipality F.E	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Municipality Cluster	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

Notes: *** denotes significance at 1 percent, ** at 5 percent, and * at 10 percent level. This table shows the impacts of good management practices on test scores for 5th and 9th grades. Test scores are from *Prova Brasil/SAEB*, the national standardized exam undertaken every two years. The school controls are white student, race not declared student, female student, student age, student per class, special needs facilities, computer lab, science lab, special education classroom, sports court, library, internet access, female teacher percentage, white teacher percentage, race not declared teacher percentage, postgraduate teacher percentage, classes per teacher. By choice, the authors decided to omit the covariate results. Municipality-specific and time trends fixed-effects are included. Standard errors are clustered by municipality.

Table B3.3 – Proficiency Results for 5th and 9th grade without entropy balance

PANEL A: Students in 5th grade										
	Mathematics					Language				
	07/09	07/11	07/13	07/15	07/17	07/09	07/11	07/13	07/15	07/17
DDD	-0.017	0.073***	0.073***	0.103***	0.077***	-0.007	0.032**	0.056***	0.090***	0.048***
	(0.014)	(0.014)	(0.016)	(0.015)	(0.015)	(0.014)	(0.015)	(0.015)	(0.015)	(0.016)
$Prog_{st=2007}$	0.015*	0.028***	0.024***	0.036***	0.030***	0.033***	0.030***	0.040***	0.032***	0.037***
	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)
$d_{09t} : Prog_{st=2007}$	0.033***	-0.001	0.014	-0.009	0.023**	0.008	-0.001	-0.009	-0.006	0.025***
	(0.009)	(0.009)	(0.010)	(0.009)	(0.009)	(0.009)	(0.009)	(0.010)	(0.009)	(0.010)
$d_{09t} : S_m$	0.075***	0.205***	0.201***	0.275***	0.338***	0.074***	0.180***	0.192***	0.304***	0.355***
	(0.010)	(0.010)	(0.011)	(0.011)	(0.011)	(0.010)	(0.010)	(0.011)	(0.011)	(0.011)
$Prog_{st=2007} : S_m$	0.028**	-0.021*	-0.010	-0.036***	-0.025**	0.008	-0.013	-0.026**	-0.018	-0.013
	(0.012)	(0.012)	(0.013)	(0.012)	(0.012)	(0.012)	(0.012)	(0.013)	(0.013)	(0.013)
Obs	160785	157955	158316	159150	160898	160785	157955	158316	159150	160898
R2 Adj.	0.092	0.126	0.122	0.219	0.252	0.082	0.111	0.132	0.241	0.283
Controls	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Year + Municipality F.E	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Municipality Cluster	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Entropy Balance	N	N	N	N	N	N	N	N	N	N
PANEL B: Students in 9 th grade										
	Mathematics					Language				
07/09	07/11	07/13	07/15	07/17	07/09	07/11	07/13	07/15	07/17	
DDD	0.009	0.027	0.016	0.080***	0.082***	0.019	0.026	0.022	0.025	0.100***
	(0.017)	(0.018)	(0.018)	(0.017)	(0.019)	(0.018)	(0.018)	(0.018)	(0.019)	(0.019)
$Prog_{st=2007}$	-0.015	-0.034***	-0.004	0.026**	0.027**	-0.022*	-0.039***	-0.006	0.011	0.016
	(0.012)	(0.012)	(0.012)	(0.012)	(0.013)	(0.012)	(0.012)	(0.013)	(0.013)	(0.013)
$d_{09t} : Prog_{st=2007}$	0.032***	0.023**	0.005	-0.013	0.020	0.033***	0.021*	0.000	0.015	0.016
	(0.011)	(0.012)	(0.012)	(0.011)	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)	(0.013)
$d_{09t} : S_m$	0.042***	0.108***	0.172***	0.173***	0.200***	0.064***	0.123***	0.181***	0.234***	0.206***
	(0.012)	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)	(0.014)
$Prog_{st=2007} : S_m$	-0.010	-0.006	-0.034**	-0.064***	-0.067***	-0.005	0.004	-0.026	-0.059***	-0.047***
	(0.016)	(0.017)	(0.017)	(0.016)	(0.017)	(0.017)	(0.017)	(0.017)	(0.018)	(0.018)
Obs	118097	116724	116465	115530	115798	118097	116724	116465	115530	115798
R2 Adj.	0.080	0.091	0.089	0.130	0.152	0.094	0.097	0.110	0.170	0.229
Controls	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Year + Municipality F.E	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Municipality Cluster	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Entropy Balance	N	N	N	N	N	N	N	N	N	N

Notes: *** denotes significance at 1 percent, ** at 5 percent, and * at 10 percent level. This table shows the impacts of good management practices on test scores for 5th and 9th grades. Test scores are from *Prova Brasil/SAEB*, the national standardized exam undertaken every two years. The school controls are white student, race not declared student, female student, student age, student per class, special needs facilities, computer lab, science lab, special education classroom, sports court, library, internet access, female teacher percentage, white teacher percentage, race not declared teacher percentage, postgraduate teacher percentage, classes per teacher. By choice, the authors decided to omit the covariate results. Unlike our main estimation, we did not use the entropy balance weight for the estimation; the results were still significant with a similar magnitude. Municipality-specific and time trends fixed-effects are included. Standard errors are clustered by municipality.

Table B3.4 – Proficiency 5th-grade - Robustness: Excluding one border state from analysis

	Mathematics					Language				
	07/09	07/11	07/13	07/15	07/17	07/09	07/11	07/13	07/15	07/17
Excluded PI										
DDD	0.018	0.068***	0.068***	0.104***	0.083***	0.012	0.021	0.049***	0.085***	0.043***
	(0.015)	(0.015)	(0.016)	(0.015)	(0.015)	(0.014)	(0.015)	(0.016)	(0.016)	(0.016)
$Prog_{st=2007}$	0.024***	0.032***	0.030***	0.034***	0.037***	0.030***	0.031***	0.035***	0.032***	0.041***
	(0.008)	(0.008)	(0.009)	(0.008)	(0.009)	(0.008)	(0.008)	(0.009)	(0.009)	(0.009)
$d_{09t} : Prog_{st=2007}$	0.008	-0.003	0.009	-0.017*	0.003	0.002	0.003	-0.001	-0.014	0.015
	(0.010)	(0.010)	(0.011)	(0.010)	(0.010)	(0.009)	(0.010)	(0.010)	(0.010)	(0.010)
$d_{09t} : S_m$	0.071***	0.204***	0.180***	0.265***	0.363***	0.085***	0.184***	0.185***	0.290***	0.371***
	(0.010)	(0.011)	(0.012)	(0.011)	(0.011)	(0.010)	(0.011)	(0.011)	(0.011)	(0.012)
$Prog_{st=2007} : S_m$	0.011	-0.030**	-0.024*	-0.041***	-0.031**	0.014	-0.013	-0.019	-0.019	-0.015
	(0.012)	(0.012)	(0.013)	(0.012)	(0.013)	(0.012)	(0.012)	(0.013)	(0.013)	(0.013)
Excluded RN										
DDD	-0.012	0.079***	0.083***	0.117***	0.074***	-0.006	0.048***	0.067***	0.115***	0.052***
	(0.015)	(0.015)	(0.017)	(0.016)	(0.016)	(0.015)	(0.015)	(0.016)	(0.016)	(0.017)
$Prog_{st=2007}$	0.027***	0.036***	0.038***	0.042***	0.046***	0.040***	0.043***	0.054***	0.044***	0.061***
	(0.009)	(0.009)	(0.010)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.010)
$d_{09t} : Prog_{st=2007}$	0.037***	-0.016	-0.009	-0.031***	0.010	0.019*	-0.025**	-0.021*	-0.046***	0.005
	(0.010)	(0.010)	(0.011)	(0.010)	(0.011)	(0.010)	(0.010)	(0.011)	(0.011)	(0.011)
$d_{09t} : S_m$	0.071***	0.203***	0.191***	0.241***	0.315***	0.092***	0.194***	0.212***	0.273***	0.343***
	(0.011)	(0.011)	(0.012)	(0.011)	(0.011)	(0.010)	(0.011)	(0.012)	(0.012)	(0.012)
$Prog_{st=2007} : S_m$	0.003	-0.037***	-0.035**	-0.052***	-0.042***	0.000	-0.030**	-0.041***	-0.034**	-0.038***
	(0.012)	(0.013)	(0.014)	(0.013)	(0.013)	(0.012)	(0.013)	(0.013)	(0.013)	(0.014)
Excluded PB										
DDD	-0.008	0.075***	0.077***	0.099***	0.075***	0.002	0.036**	0.059***	0.091***	0.048***
	(0.015)	(0.015)	(0.016)	(0.015)	(0.016)	(0.014)	(0.015)	(0.016)	(0.016)	(0.016)
$Prog_{st=2007}$	0.025***	0.036***	0.029***	0.036***	0.034***	0.035***	0.036***	0.040***	0.034***	0.039***
	(0.008)	(0.008)	(0.009)	(0.008)	(0.009)	(0.008)	(0.008)	(0.009)	(0.009)	(0.009)
$d_{09t} : Prog_{st=2007}$	0.034***	-0.010	0.000	-0.012	0.010	0.012	-0.012	-0.011	-0.020*	0.010
	(0.010)	(0.010)	(0.011)	(0.010)	(0.010)	(0.009)	(0.010)	(0.010)	(0.010)	(0.010)
$d_{09t} : S_m$	0.060***	0.189***	0.175***	0.245***	0.325***	0.075***	0.170***	0.188***	0.271***	0.337***
	(0.010)	(0.011)	(0.012)	(0.011)	(0.011)	(0.010)	(0.011)	(0.011)	(0.011)	(0.012)
$Prog_{st=2007} : S_m$	0.006	-0.035***	-0.026**	-0.045***	-0.031**	0.006	-0.020*	-0.026**	-0.023*	-0.016
	(0.012)	(0.012)	(0.013)	(0.012)	(0.013)	(0.012)	(0.012)	(0.013)	(0.013)	(0.013)
Excluded PE										
DDD	0.015	0.076***	0.061***	0.089***	0.084***	0.026	0.031*	0.050***	0.063***	0.058***
	(0.017)	(0.017)	(0.019)	(0.017)	(0.018)	(0.017)	(0.017)	(0.018)	(0.018)	(0.019)
$Prog_{st=2007}$	0.014	0.023**	0.014	0.045***	0.033***	0.032***	0.035***	0.025**	0.038***	0.037***
	(0.011)	(0.012)	(0.012)	(0.012)	(0.012)	(0.011)	(0.012)	(0.012)	(0.012)	(0.012)
$d_{09t} : Prog_{st=2007}$	0.010	-0.011	0.016	-0.002	0.002	-0.013	-0.006	-0.002	0.008	0.001
	(0.013)	(0.013)	(0.014)	(0.013)	(0.013)	(0.012)	(0.013)	(0.014)	(0.013)	(0.014)
$d_{09t} : S_m$	0.006	0.135***	0.174***	0.268***	0.301***	0.020	0.106***	0.179***	0.278***	0.310***
	(0.012)	(0.013)	(0.013)	(0.013)	(0.013)	(0.012)	(0.013)	(0.013)	(0.013)	(0.014)
$Prog_{st=2007} : S_m$	0.016	-0.025*	-0.012	-0.054***	-0.029*	0.009	-0.021	-0.011	-0.028*	-0.014
	(0.014)	(0.015)	(0.016)	(0.015)	(0.015)	(0.014)	(0.015)	(0.016)	(0.016)	(0.016)
Controls	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Year + Municipality F.E	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Municipality Cluster	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

Notes: *** denotes significance at 1 percent, ** at 5 percent, and * at 10 percent level. This table shows the impacts of good management practices on test scores for 5th grade in Ceará and border states after the TA and RBF reform, excluding one border state in each estimation. Test scores are from *Prova Brasil/SAEB*, the national standardized exam undertaken every two years. The school controls are white student, race not declared student, female student, student age, student per class, special needs facilities, computer lab, science lab, special education classroom, sports court, library, internet access, female teacher percentage, white teacher percentage, race not declared teacher percentage, postgraduate teacher percentage, classes per teacher. By choice, the authors decided to omit the covariate results. Municipality-specific and time trends fixed-effects are included. Standard errors are clustered by municipality.

Table B3.5 – Proficiency 9th-grade - Robustness: Excluding one border state from analysis

	Mathematics					Language				
	07/09	07/11	07/13	07/15	07/17	07/09	07/11	07/13	07/15	07/17
Excluded PI										
DDD	0.027	0.021	0.02	0.079***	0.101***	0.032*	0.031	0.03	0.023	0.111***
	(0.017)	(0.018)	(0.019)	(0.018)	(0.019)	(0.019)	(0.019)	(0.019)	(0.020)	(0.020)
$Prog_{st=2007}$	-0.010	-0.029**	0.001	0.011	0.023	-0.028**	-0.048***	-0.011	-0.004	0.006
	(0.013)	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)	(0.015)
$d_{09t} : Prog_{st=2007}$	0.021*	0.021	-0.002	-0.013	-0.008	0.024*	0.011	-0.010	0.023*	0.002
	(0.012)	(0.013)	(0.013)	(0.013)	(0.014)	(0.013)	(0.013)	(0.014)	(0.014)	(0.014)
$d_{09t} : S_m$	0.032***	0.108***	0.160***	0.154***	0.192***	0.070***	0.122***	0.184***	0.236***	0.201***
	(0.012)	(0.013)	(0.013)	(0.013)	(0.014)	(0.013)	(0.013)	(0.014)	(0.014)	(0.014)
$Prog_{st=2007} : S_m$	-0.015	-0.017	-0.039**	-0.053***	-0.068***	-0.002	0.006	-0.027	-0.053***	-0.041**
	(0.017)	(0.018)	(0.018)	(0.017)	(0.018)	(0.018)	(0.018)	(0.019)	(0.019)	(0.019)
Excluded RN										
DDD	0.035**	0.049***	0.029	0.114***	0.110***	0.032*	0.039**	0.036*	0.055***	0.122***
	(0.017)	(0.018)	(0.018)	(0.018)	(0.019)	(0.019)	(0.019)	(0.019)	(0.019)	(0.020)
$Prog_{st=2007}$	-0.010	-0.028**	-0.013	0.032**	0.040***	-0.017	-0.039***	-0.018	0.008	0.017
	(0.012)	(0.013)	(0.013)	(0.013)	(0.014)	(0.013)	(0.013)	(0.014)	(0.014)	(0.014)
$d_{09t} : Prog_{st=2007}$	0.015	-0.007	-0.010	-0.048***	-0.017	0.024*	0.003	-0.014	-0.009	-0.010
	(0.012)	(0.013)	(0.013)	(0.013)	(0.014)	(0.013)	(0.013)	(0.013)	(0.013)	(0.014)
$d_{09t} : S_m$	0.020	0.074***	0.147***	0.129***	0.139***	0.057***	0.102***	0.160***	0.204***	0.161***
	(0.012)	(0.013)	(0.013)	(0.013)	(0.014)	(0.013)	(0.013)	(0.014)	(0.014)	(0.014)
$Prog_{st=2007} : S_m$	-0.013	-0.014	-0.025	-0.075***	-0.081***	-0.008	-0.001	-0.018	-0.065***	-0.051***
	(0.016)	(0.017)	(0.017)	(0.017)	(0.018)	(0.017)	(0.017)	(0.018)	(0.018)	(0.018)
Excluded PB										
DDD	0.016	0.025	0	0.065***	0.071***	0.024	0.018	0.008	0.004	0.087***
	(0.018)	(0.019)	(0.019)	(0.018)	(0.020)	(0.019)	(0.019)	(0.019)	(0.020)	(0.020)
$Prog_{st=2007}$	-0.028**	-0.050***	-0.018	0.016	0.022	-0.044***	-0.070***	-0.031**	-0.012	0.002
	(0.012)	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)	(0.014)
$d_{09t} : Prog_{st=2007}$	0.033***	0.017	0.018	0.001	0.021	0.032**	0.023*	0.014	0.043***	0.026*
	(0.012)	(0.013)	(0.013)	(0.013)	(0.014)	(0.013)	(0.013)	(0.014)	(0.014)	(0.014)
$d_{09t} : S_m$	0.029**	0.102***	0.164***	0.153***	0.162***	0.051***	0.111***	0.167***	0.224***	0.173***
	(0.012)	(0.013)	(0.013)	(0.013)	(0.014)	(0.013)	(0.013)	(0.014)	(0.014)	(0.014)
$Prog_{st=2007} : S_m$	0.003	0.007	-0.022	-0.059***	-0.064***	0.015	0.029*	-0.007	-0.045**	-0.037**
	(0.016)	(0.017)	(0.017)	(0.017)	(0.018)	(0.017)	(0.017)	(0.018)	(0.018)	(0.018)
Excluded PE										
DDD	0.007	0.009	0.012	0.050**	0.026	0.013	0.011	0.012	0.006	0.067***
	(0.020)	(0.021)	(0.021)	(0.021)	(0.023)	(0.021)	(0.021)	(0.022)	(0.022)	(0.023)
$Prog_{st=2007}$	-0.010	-0.029**	0.001	0.011	0.023	-0.028**	-0.048***	-0.011	-0.004	0.006
	(0.013)	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)	(0.015)
$d_{09t} : Prog_{st=2007}$	0.021*	0.021	-0.002	-0.013	-0.008	0.024*	0.011	-0.010	0.023*	0.002
	(0.012)	(0.013)	(0.013)	(0.013)	(0.014)	(0.013)	(0.013)	(0.014)	(0.014)	(0.014)
$d_{09t} : S_m$	0.032***	0.108***	0.160***	0.154***	0.192***	0.070***	0.122***	0.184***	0.236***	0.201***
	(0.012)	(0.013)	(0.013)	(0.013)	(0.014)	(0.013)	(0.013)	(0.014)	(0.014)	(0.014)
$Prog_{st=2007} : S_m$	-0.015	-0.017	-0.039**	-0.053***	-0.068***	-0.002	0.006	-0.027	-0.053***	-0.041**
	(0.017)	(0.018)	(0.018)	(0.017)	(0.018)	(0.018)	(0.018)	(0.019)	(0.019)	(0.019)
Controls	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Year + Municipality F.E	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Municipality Cluster	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

Notes: *** denotes significance at 1 percent, ** at 5 percent, and * at 10 percent level. This table shows the impacts of good management practices on test scores for 9th grade in Ceará and border states after the TA and RBF reform, excluding one border state in each estimation. Test scores are from *Prova Brasil/SAEB*, the national standardized exam undertaken every two years. The school controls are white student, race not declared student, female student, student age, student per class, special needs facilities, computer lab, science lab, special education classroom, sports court, library, internet access, female teacher percentage, white teacher percentage, race not declared teacher percentage, postgraduate teacher percentage, classes per teacher. By choice, the authors decided to omit the covariate results. Municipality-specific and time trends fixed-effects are included. Standard errors are clustered by municipality.

Table B3.6 – Proficiency Results 5th-grade - Robustness: Using Bahia students as control

PANEL A: Students in 5th grade										
	Mathematics					Language				
	07/09	07/11	07/13	07/15	07/17	07/09	07/11	07/13	07/15	07/17
DDD	0.010	0.056***	0.096***	0.097***	0.124***	-0.001	0.023	0.065***	0.062***	0.082***
	(0.014)	(0.015)	(0.016)	(0.015)	(0.015)	(0.014)	(0.015)	(0.016)	(0.016)	(0.016)
$Prog_{st=2007}$	0.044***	0.037***	0.055***	0.044***	0.044***	0.048***	0.040***	0.057***	0.053***	0.048***
	(0.007)	(0.007)	(0.008)	(0.007)	(0.008)	(0.007)	(0.008)	(0.008)	(0.008)	(0.008)
$d_{09t} : Prog_{st=2007}$	0.011	-0.009	-0.008	-0.007	-0.026***	0.001	-0.013	-0.009	0.004	-0.026**
	(0.009)	(0.009)	(0.010)	(0.010)	(0.010)	(0.009)	(0.009)	(0.010)	(0.010)	(0.010)
$d_{09t} : S_m$	0.104***	0.205***	0.254***	0.320***	0.339***	0.143***	0.205***	0.316***	0.369***	0.356***
	(0.010)	(0.011)	(0.012)	(0.011)	(0.011)	(0.010)	(0.011)	(0.011)	(0.011)	(0.012)
$Prog_{st=2007} : S_m$	-0.020*	-0.052***	-0.074***	-0.082***	-0.062***	-0.008	-0.027**	-0.052***	-0.061***	-0.039***
	(0.012)	(0.012)	(0.013)	(0.012)	(0.012)	(0.012)	(0.012)	(0.013)	(0.013)	(0.013)
Obs	150821	146793	144470	141989	142772	150821	146793	144470	141989	142772
R2 Adj.	0.072	0.109	0.107	0.199	0.235	0.065	0.095	0.112	0.220	0.272
Controls	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Year + Municipality F.E	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Municipality Cluster	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
PANEL B: Students in 9 th grade										
	Mathematics					Language				
	07/09	07/11	07/13	07/15	07/17	07/09	07/11	07/13	07/15	07/17
DDD	0.001	0.005	0.006	0.032*	0.033*	0.047**	0.020	0.044**	0.045**	0.038*
	(0.018)	(0.019)	(0.019)	(0.019)	(0.020)	(0.019)	(0.020)	(0.020)	(0.020)	(0.020)
$Prog_{st=2007}$	0.066***	0.074***	0.057***	0.058***	0.045***	0.085***	0.076***	0.079***	0.061***	0.066***
	(0.013)	(0.014)	(0.014)	(0.013)	(0.014)	(0.014)	(0.014)	(0.015)	(0.015)	(0.015)
$d_{09t} : Prog_{st=2007}$	-0.004	0.017	0.024*	-0.001	0.020	-0.019	0.022	0.002	-0.004	0.012
	(0.013)	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)	(0.015)	(0.015)
$d_{09t} : S_m$	0.051***	0.118***	0.188***	0.265***	0.336***	0.071***	0.116***	0.191***	0.304***	0.372***
	(0.013)	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)	(0.015)	(0.015)	(0.015)	(0.015)
$Prog_{st=2007} : S_m$	-0.042**	-0.067***	-0.048***	-0.063***	-0.051***	-0.076***	-0.079***	-0.085***	-0.078***	-0.070***
	(0.017)	(0.018)	(0.018)	(0.017)	(0.018)	(0.018)	(0.018)	(0.019)	(0.019)	(0.019)
Obs	100930	99856	99996	98750	100344	100930	99856	99996	98750	100344
R2 Adj.	0.062	0.073	0.079	0.117	0.135	0.081	0.085	0.100	0.158	0.210
Controls	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Year + Municipality F.E	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Municipality Cluster	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

Notes: *** denotes significance at 1 percent, ** at 5 percent, and * at 10 percent level. This table shows the impacts of good management practices on test scores for 5th and 9th grades. Test scores are from *Prova Brasil/SAEB*, the national standardized exam undertaken every two years. We use Bahia as a control group because it had legislation similar to that of Ceará prior to 2007. The school controls are white student, race not declared student, female student, student age, student per class, special needs facilities, computer lab, science lab, special education classroom, sports court, library, internet access, female teacher percentage, white teacher percentage, race not declared teacher percentage, postgraduate teacher percentage, classes per teacher. By choice, the authors decided to omit the covariate results. Municipality-specific and time trends fixed-effects are included. Standard errors are clustered by municipality.

Table B3.7 – Retention and Abandonment

PANEL A: Students in 5th grade										
	Retention					Abandonment				
	07/09	07/11	07/13	07/15	07/17	07/09	07/11	07/13	07/15	07/17
DDD	-0.013	-0.041***	-0.042***	-0.041***	-0.031***	-0.010	0.004	-0.007	-0.019***	-0.012***
	(0.010)	(0.010)	(0.011)	(0.010)	(0.010)	(0.006)	(0.008)	(0.007)	(0.006)	(0.003)
$Prog_{st=2007}$	-0.029***	-0.022***	-0.015***	-0.020***	-0.019***	-0.005	-0.005	-0.006	-0.005	-0.004
	(0.006)	(0.005)	(0.006)	(0.005)	(0.005)	(0.003)	(0.004)	(0.004)	(0.004)	(0.003)
$d_{09t} : Prog_{st=2007}$	0.015**	0.013**	0.006	0.008	0.000	0.004	-0.007	-0.004	-0.002	0.000
	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.004)	(0.005)	(0.004)	(0.004)	(0.004)
$d_{09t} : S_m$	0.025***	0.066***	0.029***	0.014**	-0.016**	0.005	0.019***	-0.001	0.005	-0.006
	(0.007)	(0.007)	(0.008)	(0.007)	(0.007)	(0.005)	(0.006)	(0.005)	(0.005)	(0.005)
$Prog_{st=2007} : S_m$	0.039***	0.023***	0.033***	0.039***	0.035***	0.004	0.011	0.006	0.007	0.009*
	(0.009)	(0.008)	(0.009)	(0.008)	(0.008)	(0.005)	(0.007)	(0.006)	(0.005)	(0.005)
Obs	148788	147863	141495	148270	148966	151138	148745	142727	149710	150176
R2 Adj.	0.039	0.053	0.035	0.043	0.050	0.006	0.055	0.008	0.006	0.007
Controls	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Year + Municipality F.E	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Municipality Cluster	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
PANEL B: Students in 9 th grade										
	Retention					Abandonment				
	07/09	07/11	07/13	07/15	07/17	07/09	07/11	07/13	07/15	07/17
DDD	-0.010	-0.003	-0.005	-0.010	-0.006	0.007	-0.005	-0.002	0.000	-0.002
	(0.012)	(0.009)	(0.012)	(0.012)	(0.012)	(0.007)	(0.008)	(0.007)	(0.007)	(0.007)
$Prog_{st=2007}$	0.016*	0.010	0.013	0.014*	0.012	-0.010**	-0.011*	-0.011**	-0.011**	-0.015***
	(0.008)	(0.006)	(0.008)	(0.008)	(0.008)	(0.005)	(0.006)	(0.005)	(0.005)	(0.005)
$d_{09t} : Prog_{st=2007}$	-0.009	-0.008	-0.019**	-0.043***	-0.048***	0.001	0.011**	0.009**	0.003	0.009**
	(0.008)	(0.006)	(0.008)	(0.008)	(0.008)	(0.005)	(0.006)	(0.004)	(0.004)	(0.005)
$d_{09t} : S_m$	0.013	0.050***	-0.032***	-0.050***	-0.058***	-0.002	-0.014**	0.016***	0.013***	0.013***
	(0.008)	(0.007)	(0.008)	(0.008)	(0.008)	(0.005)	(0.006)	(0.005)	(0.005)	(0.005)
$Prog_{st=2007} : S_m$	0.003	0.009	0.009	0.012	0.007	0.004	0.010	0.005	0.004	0.007
	(0.011)	(0.009)	(0.011)	(0.011)	(0.011)	(0.006)	(0.008)	(0.006)	(0.006)	(0.006)
Obs	113603	113613	111500	111446	111692	114157	112789	111708	111823	112280
R2 Adj.	0.040	0.198	0.043	0.045	0.059	0.020	0.026	0.017	0.017	0.017
Controls	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Year + Municipality F.E	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Municipality Cluster	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

Notes: *** denotes significance at 1 percent, ** at 5 percent, and * at 10 percent level. This table shows the impacts of good management practices on retention and abandonment for 5th and 9th grades in Ceará and border states after the TA and RBF reform. Failure in school and dropout are questions for students from *Prova Brasil/SAEB*, the national standardized exam undertaken every two years. The municipality controls are white student, race not declared student, female student, student age, student per class, special needs facilities, computer lab, science lab, special education classroom, sports court, library, internet access, female teacher percentage, white teacher percentage, race not declared teacher percentage, postgraduate teacher percentage, classes per teacher. By choice, the authors decided to omit the covariate results. School retention refers to requiring a student to repeat a grade level due to insufficient academic progress. School abandonment occurs when, at the end of the school year, a student stops attending classes (without being transferred) but returns to school the following year. Municipality-specific and time trends fixed-effects are included. Standard errors are clustered by municipality.

Table B3.8 – Retention and Abandonment 5th-grade - Robustness: Excluding one border state from analysis

	Retention					Abandonment				
	07/09	07/11	07/13	07/15	07/17	07/09	07/11	07/13	07/15	07/17
Excluded PI										
DDD	-0.013	-0.034***	-0.033***	-0.036***	-0.023**	-0.016**	0.001	-0.008	-0.020***	-0.014**
	(0.011)	(0.010)	(0.011)	(0.010)	(0.010)	(0.007)	(0.008)	(0.007)	(0.007)	(0.007)
$Prog_{st=2007}$	-0.028***	-0.019***	-0.010*	-0.015**	-0.014**	-0.008**	-0.007	-0.008**	-0.007*	-0.004
	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.004)	(0.005)	(0.004)	(0.004)	(0.004)
$d_{09t} : Prog_{st=2007}$	0.015**	0.006	-0.003	0.003	-0.008	0.011**	-0.004	-0.003	-0.001	0.002
	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.004)	(0.006)	(0.005)	(0.004)	(0.004)
$d_{09t} : S_m$	0.025***	0.060***	0.030***	0.013*	-0.022***	0.008	0.018***	0.002	0.004	-0.007
	(0.008)	(0.007)	(0.008)	(0.007)	(0.007)	(0.005)	(0.006)	(0.005)	(0.005)	(0.005)
$Prog_{st=2007} : S_m$	0.038***	0.020**	0.028***	0.033***	0.030***	0.006	0.013*	0.008	0.009	0.010*
	(0.009)	(0.008)	(0.009)	(0.009)	(0.009)	(0.006)	(0.007)	(0.006)	(0.006)	(0.006)
Excluded RN										
DDD	-0.005	-0.052***	-0.050***	-0.049***	-0.038***	-0.005	0.002	-0.007	-0.020***	-0.014**
	(0.011)	(0.010)	(0.011)	(0.011)	(0.010)	(0.007)	(0.009)	(0.007)	(0.007)	(0.007)
$Prog_{st=2007}$	-0.031***	-0.029***	-0.022***	-0.026***	-0.027***	-0.001	0.000	-0.004	-0.001	-0.002
	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.004)	(0.005)	(0.004)	(0.004)	(0.004)
$d_{09t} : Prog_{st=2007}$	0.007	0.024***	0.015**	0.018**	0.008	0.000	-0.004	-0.003	-0.002	0.002
	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.005)	(0.006)	(0.005)	(0.005)	(0.004)
$d_{09t} : S_m$	0.016**	0.058***	0.009	-0.005	-0.037***	0.003	0.029***	-0.009*	0.001	-0.011**
	(0.008)	(0.007)	(0.008)	(0.008)	(0.007)	(0.005)	(0.006)	(0.005)	(0.005)	(0.005)
$Prog_{st=2007} : S_m$	0.041***	0.029***	0.040***	0.044***	0.043***	0.000	0.006	0.004	0.003	0.008
	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.006)	(0.007)	(0.006)	(0.006)	(0.006)
Excluded PB										
DDD	-0.009	-0.031***	-0.039***	-0.033***	-0.024**	-0.008	0.011	-0.006	-0.019***	-0.01
	(0.011)	(0.010)	(0.011)	(0.010)	(0.010)	(0.007)	(0.008)	(0.007)	(0.007)	(0.007)
$Prog_{st=2007}$	-0.026***	-0.015***	-0.014**	-0.016***	-0.015***	-0.004	-0.001	-0.005	-0.003	-0.002
	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.004)	(0.005)	(0.004)	(0.004)	(0.004)
$d_{09t} : Prog_{st=2007}$	0.010	0.003	0.002	0.001	-0.007	0.003	-0.013**	-0.005	-0.002	-0.002
	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.004)	(0.006)	(0.005)	(0.004)	(0.004)
$d_{09t} : S_m$	0.025***	0.052***	0.025***	0.010	-0.024***	0.005	0.017***	-0.002	0.007	-0.006
	(0.008)	(0.007)	(0.008)	(0.007)	(0.007)	(0.005)	(0.006)	(0.005)	(0.005)	(0.005)
$Prog_{st=2007} : S_m$	0.036***	0.016*	0.032***	0.035***	0.032***	0.002	0.007	0.005	0.005	0.007
	(0.009)	(0.008)	(0.009)	(0.009)	(0.008)	(0.006)	(0.007)	(0.006)	(0.006)	(0.005)
Excluded PE										
DDD	-0.034***	-0.061***	-0.054***	-0.053***	-0.054***	-0.01	0.005	-0.007	-0.017**	-0.01
	(0.012)	(0.011)	(0.012)	(0.012)	(0.012)	(0.008)	(0.010)	(0.008)	(0.008)	(0.007)
$Prog_{st=2007}$	-0.030***	-0.035***	-0.018**	-0.033***	-0.024***	-0.009*	-0.015**	-0.006	-0.010*	-0.009*
	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.005)	(0.007)	(0.005)	(0.005)	(0.005)
$d_{09t} : Prog_{st=2007}$	0.036***	0.033***	0.018*	0.021**	0.023***	0.005	-0.007	-0.003	-0.003	-0.002
	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.006)	(0.007)	(0.006)	(0.006)	(0.006)
$d_{09t} : S_m$	0.039***	0.115***	0.068***	0.055***	0.045***	0.006	0.007	0.010*	0.008	0.000
	(0.009)	(0.008)	(0.009)	(0.009)	(0.008)	(0.005)	(0.007)	(0.006)	(0.006)	(0.005)
$Prog_{st=2007} : S_m$	0.040***	0.036***	0.037***	0.051***	0.040***	0.007	0.020**	0.007	0.012*	0.015**
	(0.011)	(0.010)	(0.011)	(0.010)	(0.010)	(0.007)	(0.008)	(0.007)	(0.007)	(0.006)
Controls	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Year + Municipality F.E	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Municipality Cluster	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

Notes: *** denotes significance at 1 percent, ** at 5 percent, and * at 10 percent level. This table shows the impacts of good management practices on retention and abandonment for 5th and 9th grades in Ceará and border states after the TA and RBF reform. Failure in school and dropout are questions for students from *Prova Brasil/SAEB*, the national standardized exam undertaken every two years. The municipality controls are white student, race not declared student, female student, student age, student per class, special needs facilities, computer lab, science lab, special education classroom, sports court, library, internet access, female teacher percentage, white teacher percentage, race not declared teacher percentage, postgraduate teacher percentage, classes per teacher. By choice, the authors decided to omit the covariate results. School retention refers to requiring a student to repeat a grade level due to insufficient academic progress. School abandonment occurs when, at the end of the school year, a student stops attending classes (without being transferred) but returns to school the following year. Municipality-specific and time trends fixed-effects are included. Standard errors are clustered by municipality.

Table B3.9 – Retention and Abandonment 9th-grade - Robustness: Excluding one border state from analysis

	Retention					Abandonment				
	07/09	07/11	07/13	07/15	07/17	07/09	07/11	07/13	07/15	07/17
Excluded PI										
DDD	0	-0.011	-0.006	0.029**	-0.02	0.008	0.001	-0.002	-0.005	-0.004
	(0.012)	(0.010)	(0.012)	(0.012)	(0.012)	(0.007)	(0.009)	(0.007)	(0.007)	(0.007)
$Prog_{st=2007}$	0.024***	0.024***	0.016*	0.026***	0.028***	-0.012**	-0.013**	-0.011**	-0.011**	-0.014***
	(0.009)	(0.007)	(0.009)	(0.009)	(0.009)	(0.005)	(0.007)	(0.005)	(0.005)	(0.005)
$d_{09t} : Prog_{st=2007}$	-0.018**	-0.021***	-0.019**	-0.061***	-0.062***	0.000	0.006	0.009*	-0.002	0.003
	(0.009)	(0.007)	(0.009)	(0.009)	(0.009)	(0.005)	(0.006)	(0.005)	(0.005)	(0.005)
$d_{09t} : S_m$	0.011	0.053***	-0.032***	-0.053***	-0.057***	-0.001	-0.002	0.019***	0.012**	0.014***
	(0.009)	(0.007)	(0.009)	(0.009)	(0.009)	(0.005)	(0.006)	(0.005)	(0.005)	(0.005)
$Prog_{st=2007} : S_m$	-0.006	-0.004	0.007	0.001	-0.010	0.005	0.014	0.005	0.004	0.005
	(0.012)	(0.010)	(0.012)	(0.012)	(0.012)	(0.007)	(0.008)	(0.007)	(0.007)	(0.007)
Excluded RN										
DDD	-0.019	-0.002	-0.008	-0.018	-0.009	0.003	-0.007	-0.003	-0.004	-0.004
	(0.012)	(0.010)	(0.012)	(0.012)	(0.012)	(0.007)	(0.009)	(0.007)	(0.007)	(0.007)
$Prog_{st=2007}$	0.009	0.012*	0.016*	0.016*	0.013	-0.012**	-0.011*	-0.011**	-0.013***	-0.016***
	(0.009)	(0.007)	(0.009)	(0.009)	(0.009)	(0.005)	(0.006)	(0.005)	(0.005)	(0.005)
$d_{09t} : Prog_{st=2007}$	0.000	-0.012*	-0.022**	-0.050***	-0.051***	0.005	0.013**	0.010**	0.007	0.011**
	(0.009)	(0.007)	(0.009)	(0.009)	(0.009)	(0.005)	(0.006)	(0.005)	(0.005)	(0.005)
$d_{09t} : S_m$	0.028***	0.041***	-0.026***	-0.062***	-0.066***	0.001	-0.009	0.018***	0.016***	0.015***
	(0.009)	(0.007)	(0.009)	(0.009)	(0.009)	(0.005)	(0.006)	(0.005)	(0.005)	(0.005)
$Prog_{st=2007} : S_m$	0.009	0.007	0.006	0.010	0.006	0.005	0.010	0.004	0.005	0.007
	(0.012)	(0.009)	(0.012)	(0.011)	(0.011)	(0.007)	(0.008)	(0.007)	(0.006)	(0.006)
Excluded PB										
DDD	-0.012	-0.002	-0.009	-0.006	-0.004	0.006	-0.006	-0.001	0.001	-0.002
	(0.012)	(0.010)	(0.013)	(0.012)	(0.012)	(0.007)	(0.009)	(0.007)	(0.007)	(0.007)
$Prog_{st=2007}$	0.017*	0.011*	0.015*	0.014	0.012	-0.008	-0.009	-0.011**	-0.009*	-0.015***
	(0.009)	(0.007)	(0.009)	(0.008)	(0.008)	(0.005)	(0.006)	(0.005)	(0.005)	(0.005)
$d_{09t} : Prog_{st=2007}$	-0.006	-0.009	-0.023***	-0.039***	-0.047***	0.002	0.012*	0.008	0.002	0.009*
	(0.009)	(0.007)	(0.009)	(0.009)	(0.009)	(0.005)	(0.006)	(0.005)	(0.005)	(0.005)
$d_{09t} : S_m$	0.014	0.043***	-0.038***	-0.055***	-0.065***	0.001	-0.013**	0.016***	0.012**	0.014***
	(0.009)	(0.007)	(0.009)	(0.009)	(0.009)	(0.005)	(0.006)	(0.005)	(0.005)	(0.005)
$Prog_{st=2007} : S_m$	0.002	0.008	0.007	0.013	0.007	0.001	0.009	0.005	0.002	0.007
	(0.011)	(0.009)	(0.011)	(0.011)	(0.011)	(0.007)	(0.008)	(0.006)	(0.006)	(0.006)
Excluded PE										
DDD	-0.009	-0.030***	-0.008	-0.023	-0.022	0.011	-0.01	-0.005	-0.002	-0.009
	(0.014)	(0.011)	(0.014)	(0.014)	(0.014)	(0.008)	(0.010)	(0.008)	(0.008)	(0.008)
$Prog_{st=2007}$	0.012	-0.013	0.001	-0.003	-0.017	-0.011	-0.007	-0.010	-0.011*	-0.018***
	(0.012)	(0.009)	(0.012)	(0.012)	(0.012)	(0.007)	(0.008)	(0.007)	(0.007)	(0.007)
$d_{09t} : Prog_{st=2007}$	-0.010	0.019**	-0.006	-0.010	-0.021*	-0.003	0.016**	0.012**	0.005	0.016**
	(0.011)	(0.008)	(0.011)	(0.011)	(0.011)	(0.006)	(0.008)	(0.006)	(0.006)	(0.006)
$d_{09t} : S_m$	-0.007	0.069***	-0.031***	-0.019*	-0.034***	-0.009*	-0.041***	0.009	0.009*	0.008
	(0.010)	(0.008)	(0.010)	(0.010)	(0.010)	(0.006)	(0.007)	(0.006)	(0.005)	(0.006)
$Prog_{st=2007} : S_m$	0.009	0.032***	0.021	0.030**	0.035**	0.005	0.007	0.004	0.004	0.011
	(0.014)	(0.011)	(0.014)	(0.014)	(0.014)	(0.008)	(0.010)	(0.008)	(0.008)	(0.008)
Controls	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Year + Municipality F.E	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Municipality Cluster	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

Notes: *** denotes significance at 1 percent, ** at 5 percent, and * at 10 percent level. This table shows the impacts of good management practices on retention and abandonment for 5th and 9th grades in Ceará and border states after the TA and RBF reform. Failure in school and dropout are questions for students from *Prova Brasil/SAEB*, the national standardized exam undertaken every two years. The municipality controls are white student, race not declared student, female student, student age, student per class, special needs facilities, computer lab, science lab, special education classroom, sports court, library, internet access, female teacher percentage, white teacher percentage, race not declared teacher percentage, postgraduate teacher percentage, classes per teacher. By choice, the authors decided to omit the covariate results. School retention refers to requiring a student to repeat a grade level due to insufficient academic progress. School abandonment occurs when, at the end of the school year, a student stops attending classes (without being transferred) but returns to school the following year. Municipality-specific and time trends fixed-effects are included. Standard errors are clustered by municipality.

Table B3.10 – Retention and Abandonment Results for 5th and 9th grade - Robustness: Using Bahia students as control

PANEL A: Students in 5th grade										
	Retention					Abandonment				
	07/09	07/11	07/13	07/15	07/17	07/09	07/11	07/13	07/15	07/17
DDD	-0.004	-0.034***	-0.040***	-0.028***	-0.048***	0.006	-0.011	-0.004	-0.025***	-0.027***
	(0.011)	(0.010)	(0.011)	(0.011)	(0.011)	(0.007)	(0.008)	(0.007)	(0.007)	(0.007)
$Prog_{st=2007}$	-0.029***	-0.024***	-0.029***	-0.024***	-0.023***	-0.013***	-0.009**	-0.013***	-0.009**	-0.010***
	(0.006)	(0.005)	(0.006)	(0.005)	(0.005)	(0.004)	(0.004)	(0.004)	(0.003)	(0.003)
$d_{09t} : Prog_{st=2007}$	0.002	0.005	0.008	-0.005	0.014**	-0.009**	0.001	-0.003	0.008*	0.012***
	(0.007)	(0.006)	(0.007)	(0.007)	(0.007)	(0.004)	(0.005)	(0.005)	(0.004)	(0.004)
$d_{09t} : S_m$	-0.014*	0.157***	0.014*	0.023***	0.018**	-0.007	0.074***	0.005	0.021***	0.010*
	(0.008)	(0.007)	(0.008)	(0.008)	(0.008)	(0.005)	(0.006)	(0.005)	(0.005)	(0.005)
$Prog_{st=2007} : S_m$	0.040***	0.025***	0.050***	0.043***	0.038***	0.013**	0.019***	0.015***	0.013**	0.017***
	(0.009)	(0.008)	(0.009)	(0.009)	(0.008)	(0.006)	(0.007)	(0.006)	(0.006)	(0.006)
Obs	137855	136023	126523	130677	130018	140635	136874	128082	132263	131217
R2 Adj.	0.035	0.077	0.033	0.041	0.051	0.008	0.042	0.008	0.006	0.007
Controls	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Year + Municipality F.E	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Municipality Cluster	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
PANEL B: Students in 9 th grade										
	Retention					Abandonment				
	07/09	07/11	07/13	07/15	07/17	07/09	07/11	07/13	07/15	07/17
DDD	-0.024*	-0.028***	-0.009	-0.006	-0.004	-0.023***	-0.009	-0.009	-0.001	-0.006
	(0.013)	(0.010)	(0.013)	(0.013)	(0.012)	(0.007)	(0.009)	(0.007)	(0.007)	(0.007)
$Prog_{st=2007}$	-0.017*	0.002	-0.002	-0.004	-0.007	0.002	0.002	0.004	0.004	-0.002
	(0.009)	(0.007)	(0.009)	(0.009)	(0.009)	(0.005)	(0.007)	(0.005)	(0.005)	(0.005)
$d_{09t} : Prog_{st=2007}$	-0.024**	-0.024***	-0.012	-0.016*	-0.027***	-0.019***	-0.003	-0.007	-0.008	-0.004
	(0.009)	(0.007)	(0.009)	(0.009)	(0.009)	(0.005)	(0.007)	(0.005)	(0.005)	(0.005)
$d_{09t} : S_m$	-0.020**	-0.035***	-0.029***	-0.056***	-0.084***	0.000	-0.038***	0.009*	0.013**	0.012**
	(0.009)	(0.007)	(0.009)	(0.009)	(0.009)	(0.005)	(0.007)	(0.005)	(0.005)	(0.005)
$Prog_{st=2007} : S_m$	0.009	-0.007	0.005	0.017	0.015	0.001	0.015*	-0.001	0.001	0.007
	(0.012)	(0.009)	(0.012)	(0.012)	(0.012)	(0.007)	(0.009)	(0.007)	(0.007)	(0.007)
Obs	96869	97188	95590	95008	96618	97371	96458	95795	95353	97199
R2 Adj.	0.037	0.197	0.039	0.043	0.054	0.017	0.029	0.014	0.014	0.014
Controls	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Year + Municipality F.E	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Municipality Cluster	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

Notes: *** denotes significance at 1 percent, ** at 5 percent, and * at 10 percent level. This table shows the impacts of good management practices on retention and abandonment for 5th and 9th grades in Ceará and border states after the TA and RBF reform. Failure in school and dropout are questions for students from *Prova Brasil/SAEB*, the national standardized exam undertaken every two years. The municipality controls are white student, race not declared student, female student, student age, student per class, special needs facilities, computer lab, science lab, special education classroom, sports court, library, internet access, female teacher percentage, white teacher percentage, race not declared teacher percentage, postgraduate teacher percentage, classes per teacher. By choice, the authors decided to omit the covariate results. School retention refers to requiring a student to repeat a grade level due to insufficient academic progress. School abandonment occurs when, at the end of the school year, a student stops attending classes (without being transferred) but returns to school the following year. Municipality-specific and time trends fixed-effects are included. Standard errors are clustered by municipality.

Table B3.11 – Variables from SAEB used to estimate the SMQI

SMQI questions	Answer	SAEB question
1) Standardization of Instructional Processes		
a) How structured or standardized are the instructional planning processes across the school?	Teacher	In your perception, the possible learning problems of students in the evaluated grade(s) or year(s) occur in this school due to Non-compliance with the curricular contents throughout the student's school trajectory.
	Teacher	In your perception, the possible learning problems of students in the evaluated grade(s) or year(s) occur in this school due to Teachers' workload, making planning and preparation difficult for classes.
	Teacher	How much of the predicted content were you able to develop with the students in this class this year?
b) What tools and resources are provided to teachers(e.g., standards-based lesson plan and textbooks) to ensure consistent level of quality in delivery across classroom	Principal	How did you choose the textbook this year?
	Teacher	Do students in this class have textbooks?

Table B3.11 – Variables from SAEB used to estimate the SMQI

SMQI questions	Answer	SAEB question
	Teacher	We would like to know which resources you use for teaching purposes in this class: Newspapers and informative magazines.
	Teacher	We would like to know what resources you use for teaching purposes in this class: Literature books.
	Teacher	We would like to know which resources you use for teaching purposes in this class: Copy machine (Xerox).
d) How does the school leader monitor and ensure consistency in quality across the classroom	Teacher	In this school and this year, indicate how often: The principal pays special attention to aspects related to student learning.
2) Personalizing of Instructions and Learning		
a) How often does the school identify individual students' needs? How are these needs accommodated within the classroom?	Teacher	In your perception, the possible learning problems of the students of the grade(s) or year(s) evaluated occur in this school due to the following: Curriculum contents are inadequate to the needs of the students.

Table B3.11 – Variables from SAEB used to estimate the SMQI

SMQI questions	Answer	SAEB question
c) What about students? How does the school ensure they are engaged in their own learning? How are parents incorporated in this process?	Principal	Indicate how often the following activities are carried out to minimize student absences this year and at this school: Teachers talk to students to solve the problem.
	Principal	Indicate how often the following activities are carried out to minimize student absences this year and at this school: Parents/-guardians are notified by communication from the school
	Principal	Indicate how often the following activities are carried out to minimize student absences this year and at this school: Parents/-guardians are called to the school to discuss the matter in a parent meeting.
	Principal	Indicate how often the following activities are carried out to minimize student absences this year and at this school: Parents/guardians are called to the school to talk about the matter individually.

Table B3.11 – Variables from SAEB used to estimate the SMQI

SMQI questions	Answer	SAEB question
	Principal	Indicate how often the following activities are carried out to minimize student absences this year and at this school: The school sends someone to the student's home.
	Teacher	In your perception, the possible learning problems of students in the evaluated grade(s) or year(s) occur at this school due to parents' lack of assistance and monitoring during the student's school life.
	Teacher	In your perception, the possible learning problems of students in the grade(s) or year(s) evaluated occur at this school due to: Disinterest and lack of effort on the part of the student.
	Teacher	In your perception, the possible learning problems of students in the grade(s) or year(s) assessed occur at this school due to the high rate of absences by students.
4) Adopting educational best practices		
a) How does the school encourage incorporating new teaching practices into the classroom	Principal	How many teachers at this school participated in the continuing education activities you organized in the last two years?

Table B3.11 – Variables from SAEB used to estimate the SMQI

SMQI questions	Answer	SAEB question
	Teacher	In this school and this year, indicate how often: The principal encourages innovative activities.
c) How does the school ensure that teachers use these new practices in the classroom? How often does this happen	Teacher	In this school and this year, indicate how often: The principal pays special attention to aspects related to student learning.
7) Performance Review		
a) How often do you review (school) performance- formally or informally - with teachers and staff	Principal	The Class Council comprises all teachers in each class/grade. How many times did the Class Council meet this year and in this school?
	Teacher	The Class Council comprises all teachers in each class/grade. How many times did the Class Council meet this year and in this school?
17) Promoting High Performers		
b) How do you identify and develop your star performers?	Teacher	In your perception, the possible learning problems of students in the evaluated grade(s) or year(s) occur in this school due to Teacher dissatisfaction and discouragement with the teaching career.

Table B3.11 – Variables from SAEB used to estimate the SMQI

SMQI questions	Answer	SAEB question
	Principal	In the last two years, have you organized any continuing education activities (updating, training, qualification, etc.) at this school?
18) Managing Talent		
b) How do you ensure you have enough teachers of the right type in the school?	Principal	This year, what was the main criterion for assigning classes to teachers?
20) Attracting Talent/ Creating a Distinctive Employee Value Proposition		
a) What makes it distinctive to teach at your school, unlike other similar schools? If you were to ask the last three candidates, would they agree? Why?	Teacher	This school year and this year indicate how often the principal encourages and motivates me to work.
	Teacher	In this school and this year, indicate how often I feel respected by the principal.
	Teacher	This school and this year indicate how often I have confidence in the principal as a professional.
	Teacher	In this school and this year, indicate how often I participate in decisions related to my work.

Table B3.11 – Variables from SAEB used to estimate the SMQI

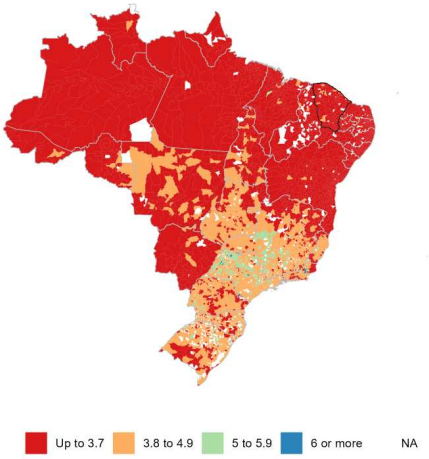
SMQI questions	Answer	SAEB question
	Teacher	At this school and this year, please indicate how often The teaching staff considers my ideas.

APPENDIX C – CHAPTER 4

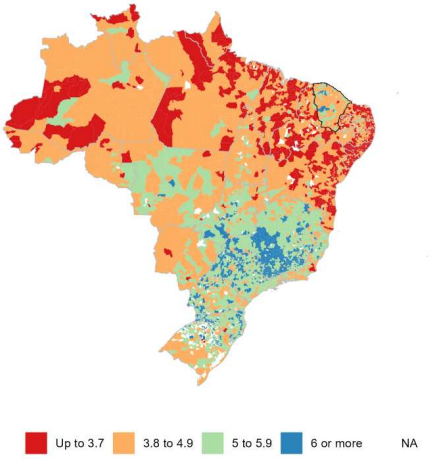
C1 - Additional figures

Figure C1.1 – Average evolution of municipalities to IDEB in primary years

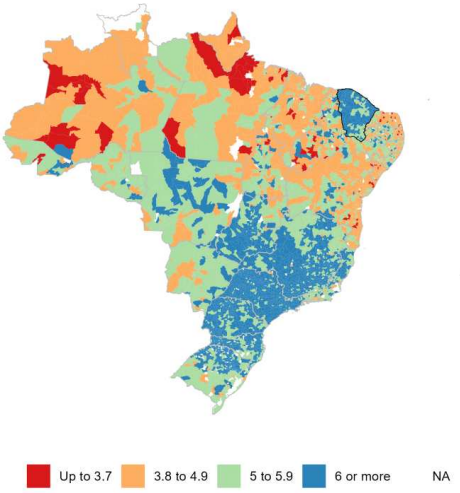
(a) IDEB 2005



(b) IDEB 2011

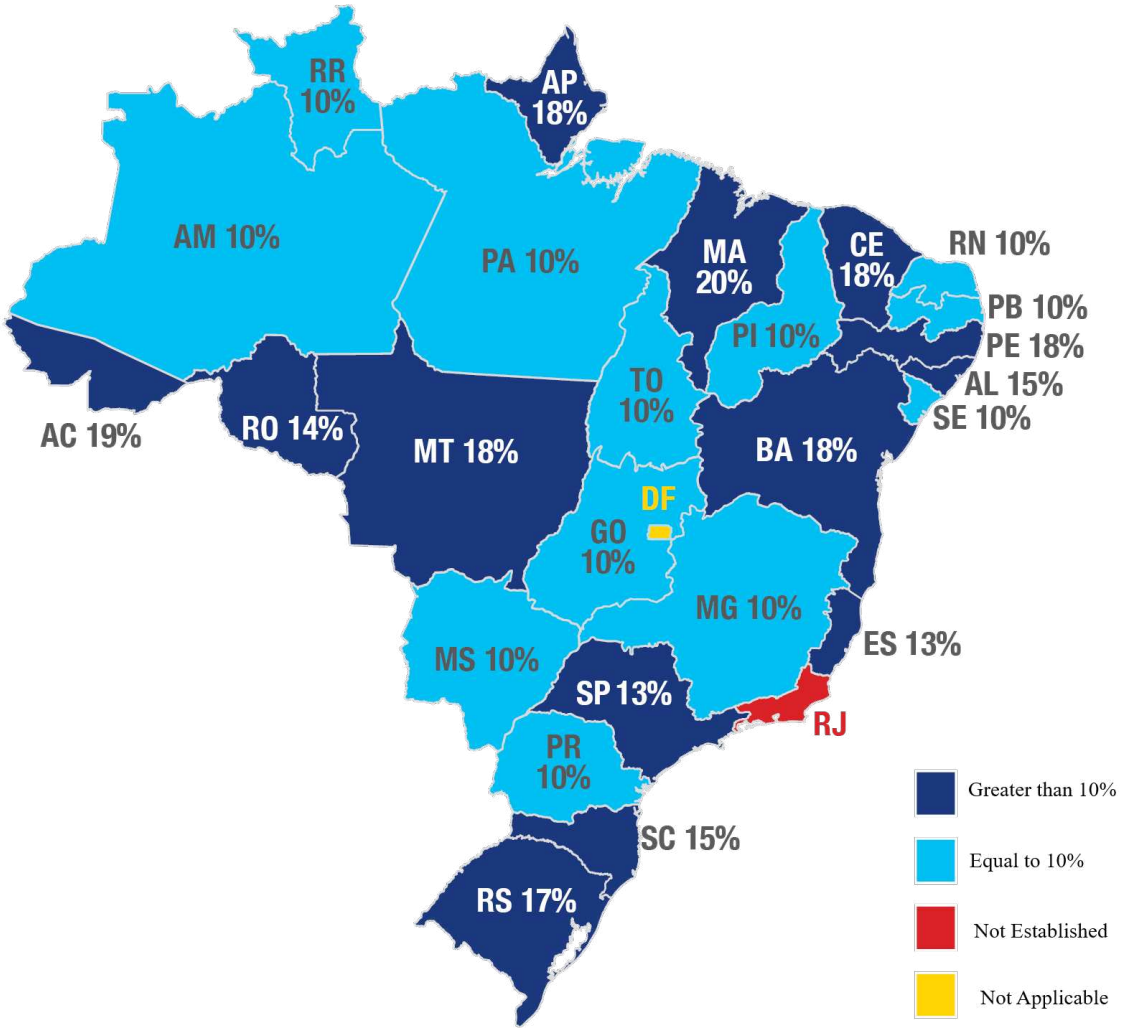


(c) IDEB 2019



Note: The maps show the evolution of IDEB in the primary years of 2005, 2011, and 2019. Ceará recorded the most significant historical evolution, from 2.8 in 2005 to 6.3 in 2019. In addition, 131 municipalities in Ceará reached an average of 6 for this stage of education in 2019. Still, according to the indicator, in 2019, 21 municipalities and 79 schools are among the 100 best-rated in the initial grades

Figure C1.2 – Percentage Distribution of ICMS Linked to Educational Outcomes in Brazil



Note: Note: Figure C1.2 is a map of Brazil showing the ICMS (Tax on the Circulation of Goods and Services) rate for each state. The colors represent different rate ranges: light blue for states with a rate equal to 10%, dark blue for those with a rate above 10%, red for the state where ICMS is not instituted, and yellow for states where it does not apply. Twenty-five out of the 26 states already have their laws in effect, except Rio de Janeiro. Notably, the share shown in the chart reflects the final distribution mandated by law. However, as some states are still in a transition period, gradually adjusting amounts over time, the current figures may vary from those depicted in the chart. Source: (Todos Pela Educação, 2023)

C2 - Additional tables

Table C2.1 – Summary Statistics

Variable	Obs	Mean	SD	Min	Max
population size	2453	46851.107	189344.035	3632	2609716
total spending	2453	60985328	280108465.381	2904592.11424	5960404444.8
spending on education	2453	19343711	55273691.7878	48996.5514253	1147099622.24
spending on primary education	2453	14035782	39623631.6099	0	813009044.14
GDP	2453	447544.35	3021839.52039	9508.53343864	60212580.3096
FPM	2525	14600306	38540951.6963	1575605.25	768149696
FUNDEB	2517	13490497	31010444.0692	4062.03515625	607000576
ICMS transfers	2524	7591082.9	43770242.0899	451462.15625	915825344
Non-literate	38261	9.753	14.274	0	100
Intermediary	38261	12.667	15.025	0	100
Sufficient	38261	14.884	15.747	0	100
Desirable	38261	50.487	34.294	0	100
Specialization studies	35264	.201	.247	0	1
postgraduate studies	35264	.0028	.0360	0	1
Age_1	38227	.089	.155	0	1
Age_2	38227	.1537	.190	0	1
Age_3	38227	.383	.250	0	1
Age_4	38227	.298	.2455	0	1
Gender	38227	.808	.2055	0	1
White	38227	.169	.2090	0	1
Approval $rate_1$	36516	94.870	11.838	0	100
Approval $rate_2$	38128	91.760	14.314	0	100
Abandonment $Rate_1$	36516	1.468	5.071	0	100
Abandonment $Rate_2$	38128	1.121	4.246	0	100
Proficiency SPAECE-Alfa	38261	152.072	49.308	29.654	294.545

Note: The results on municipal expenditure are from 2004 until 2017. Otherwise educational data are from 2007 to 2015

Table C2.2 – Description of the Variables Used for Educational Results

Variable	Description
Approval rate	The proportion of students from first and 2nd year of elementary school approved
Abandonment Rate	The proportion of 1st and 2nd Year Elementary School students who dropped out of school
Proficiency SPAECE-Alfa	Average proficiency of students in the 2nd year of elementary school at SPAECE-Alfa
Non-literate	Percentage of illiterate students (SPAECE -Alfa)
Incomplete Literacy	Percentage of students with incomplete literacy (SPAECE-Alfa)
Intermediary	Percentage of students with Intermediate literacy (SPAECE-Alfa)
Sufficient	Percentage of students with sufficient literacy (SPAECE-Alfa)
Desirable	Percentage of students with Desirable literacy (SPAECE-Alfa)
White	Average of professors declared with color/race White
Gender	Average of female teachers
Age_1	Average age of teachers up to 24 years
Age_2	Average age of teachers from 24 to 29 years old
Age_3	Average age of teachers from 30 to 39 years old
Age_4	Average age of teachers from 40 to 49 years
Specialization studies	Average of teachers with specialization
postgraduate studies	Average of professors with master's and/or doctorate degrees

Table C2.3 – Description of the Variables Used for the Mechanism

Variable	Description
Teacher's Regularity	Indicator to evaluate the regularity of the teaching staff in the schools of basic education from the observation of the permanence of the teachers in the schools in the last five years
Teacher's Adequacy	Teachers with a higher education degree (or bachelor's degree with pedagogical complementation) in an area different combination that you teach.
Management Complexity	The school management complexity indicator summarizes the size, operating shifts, level of complexity of the steps, and the number of steps offered in a single measure.
Teaching effort I	A teacher who, in general, has up to 25 students and works in a single shift, school, and stage.
Teaching efforts II	A teacher who, in general, has between 25 and 150 students and works in a single shift, school, and stage
Teaching effort III	A teacher who has between 25 and 300 students and works in one or two shifts in a single school and stage.
Students Per Class	1/Average Students per Class
Class Duration	Duration of school hours in minutes
Teachers with a college degree	Percentage of teachers with higher education at school in the early years
Principal Component Analysis (PCA)	Combination of indicators Teacher's Regularity; Teacher's Adequacy; Management Complexity Teaching effort I; Teaching effort II; Teaching effort III, standardized duration class and students per class using the Principal Component Analysis methodology