COMO O PROGRAMA BOLSA FAMÍLIA IMPACTA NA EDUCAÇÃO BÁSICA? UMA ANÁLISE PARA O NORDESTE DO BRASIL

How bolsa família program impacts on basic education? An analysis for the Brazilian Northeast[1]

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Resumo: O presente trabalho tem como objetivo investigar o impacto do Programa Bolsa Família sobre os indicadores educacionais, taxa de matrícula e defasagem escolar, das crianças de 6 a 17 anos dos estados e mesorregiões da região Nordeste, tendo como base os dados do Censo de 2010. Para estimação dos resultados foi utilizado o método do *Propensity Score Matching*, aplicando como robustez estimações complementares e análise de sensibilidade. A diferenciação deste estudo são as estimativas com base nos estados do Nordeste e suas respectivas mesorregiões, de forma mais desagregada, uma vez que a literatura enfoca, principalmente, uma análise mais geral. Os resultados indicaram que o PBF possui impacto significativo sobre a taxa de matrícula, com esse efeito permanecendo na análise de robustez. Contudo, para defasagem escolar, os impactos se mostraram em geral não significativos e/ou não robustos. Ademais, observa-se que o efeito é maior para os indivíduos de 15 a 17 anos, apesar de que nessa faixa, o programa possui maior heterogeneidade entre as mesorregiões e na área rural, com casos de impacto não significativo mesmo sobre a taxa de matrícula. Dessa forma, observa-se a importância do PBF como incentivo, porém, há desafios principalmente para essa faixa etária mais velha, sendo que políticas educacionais podem ser importantes para melhoria desses indicadores.
Palavras-chave: PBF; indicadores educacionais; Nordeste; condicionalidades.

Abstract: This paper aims to investigate the Bolsa Família Program impacts on educational indicators, such as enrollment rate and age-grade gap, in the Northeast region and its respective states and mesoregions, for children and teenagers from 6 to 17 years old, using as source the 2010 Census. The Propensity Score Matching method was used for estimation, and complementary tools and sensitivity analysis were applied. The study differentiation is the Northeast states and their respective mesoregions estimation, in a more disaggregated way, since the literature focuses mainly on general analysis. The results indicated a significant impact of PBF on the enrollment rate, and it remains on robustness analysis. However, for the age-grade gap, in general, the impacts were not significant and/or not robust. Also, the observed effect is greater for individuals aged from 15 to 17 years, although in this age range, the program has greater heterogeneity among mesoregions, with non-significant impact cases even for enrollment rate. Thus, is observed the importance of PBF as an incentive, though there are challenges mainly for this older group, and educational policies may be important for improvement of these indicators.
Keywords: PBF; educational indicators; Northeast; conditionalities.

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1 INTRODUCTION

The *Programa Bolsa Família* (PBF) is a cash transfer program which requires conditionalities. Its central objective is the relief of people in a vulnerable situation in the short-term and, in the long term, overcoming the intergenerational cycle of poverty. One condition imposed is that beneficiaries must keep their children enrolled and with minimal school attendance and can thus generate effects on educational indicators.

In the last decades, the Brazilian educational system has shown signs of development, especially post 1988 Constitution, which turned education into a civil right in Brazil, boosting enrollment rates and reducing the age-grade gap.

The human capital theory states that the higher educational level one gets, the bigger will tend to be his future salary. Pioneers of this perspective Mincer (1958), Schultz (1963), and Becker (1964) argue that education is a key to better understand the labor and capital relationship. Thus, PBF seeks to encourage human capital investment in its beneficiaries through its educational conditionality, with the long-term objective of ceasing the poverty cycle transmitted across generations.

Several papers tested social programs impacts on education. Reynolds (2015) features similar programs to PBF which were implemented in Latin America, just as the Opportunity Program in Mexico, which found a school enrollment increase from 9 to 14.4 percentage points. Also, Program Families in Action in Colombia, which had a very positive response in school attendance for all children.

Regarding PBF, Glewwe and Kassouf (2012), Silveira Neto (2010), Melo and Duarte (2010), Schaffland (2012), and Kern, Vieira and Freguglia's (2017) analysis detected greater probability for beneficiaries to complete school enrollment. Another finding of the program related to education can be consulted in Romero and Hermeto (2009), Araújo, Ribeiro, and Neder (2010), and Amaral and Monteiro (2013), according to these papers, PBF was important in reducing school dropout. Oliveira and Soares (2013) and Brauw *et al.* (2015) indicate that PBF reduces the beneficiaries school repetition rate . Regarding qualitative indicators, Silva et al. (2016) found that beneficiaries improved their results in Portuguese and Mathematics by 18% and 15%, respectively.

Although the mentioned literature presents important contributions in this field, this article intends to contribute differently, considering the possibility of impact heterogeneities along Northeast different states and mesoregions, in a more disaggregated way. The reason why Northeast is chosen lays on the fact that there is the highest proportion of poor in the country and it also has the larger number of PBF beneficiaries in Brazil.

Also, data disaggregation from regional territory to subdivisions in states and, within each state its mesoregions, aim to capture even more specifically and forcefully the local poverty differential in that region. Brazil is an unequal country with income concentration in some places and severe poverty in others. Resources, industry, education, and government facilities are not well distributed on geographic space. In the Northeast region is the same on a smaller scale, but with a historical trend to be one of the country's most delayed regions.

The Northeast negative highlight is the semi-arid, which covers 53% of the territory, and is present in eight of nine states. In this geographic space, rainfall is scarce and poorly distributed, which makes agricultural and livestock farming difficult. The constant droughts make life difficult for its inhabitants and have caused strong migration to the South. In order to capture these disparities between smaller regions and its peculiarities, data must be collected regarding smaller pieces of territory.

Therefore, this article intends to contribute analyzing the impact of *PBF* educational conditionality on enrollment rate and age-grade gap, for children and teenagers from 6-17 years old, based on Demographic Census data, regarding Northeastern states and its mesoregions. To obtain such specific results, the Propensity Score Matching method and sensitive analysis will be applied.

The paper proceeds as follows. Section 2 presents a brief description of the PBF, conditionalities, and objectives. Section 3 provides a literature review on the impact of PBF on educational indicators. Section 4 describes the data and statistics for treatment through the

Propensity Score Matching method. Section 5 presents our results and discussions. Section 6 has our final remarks.

2 A SHORT DESCRIPTION OF PBF

The *Bolsa Família* Program was created in 2003, becoming law in 2004. It was created from the combination of existing programs, incorporating more efficient monitoring of families in vulnerability situation, based on the Unique Register of the Federal Government (CadÚnico).

The PBF management takes place in a decentralized way, with the active participation of the Union, States, and Municipalities, based on three main axes: I) Income complementation; ii) Access to civil rights, and; iii) Articulation with other programs.

Since its creation, *PBF* presented structural framework readjustments as well as several changes on its eligibility line and benefit value. For instance, in 2007, teenagers (16/17 years old) were included but restricted to the limit of two per family. Another change, in 2011, was the benefit expansion from three to five children per family. In 2012, the *Brazil Carinhoso* Program (PBC) was created, focusing on families who remained in extreme poverty even after receiving the benefit, to help them to overcome this condition (Osorio and Souza, 2012).

In 2010, extremely poor families (up to R$ 70.00 *per capita* income) were eligible to join the program, with a basic benefit of R$ 68.00 and a variable benefit according to their family composition. This benefit was also available to families living in poverty (up to R$ 140.00 *per capita* income). The variable benefit was limited to three children (R$ 22.00 per person) and two teenagers per family (R$ 46.00 per person).

PBF is a conditional cash transfer program, in which both Government and beneficiaries have obligations, to increase its effective power. Thus, education, health, and social assistance areas are covered for its conditionalities.

As a counterpart in education, beneficiaries must enroll children and teenagers between 6 and 17 years old in school. Moreover, kids must have school attendance at least by 85% (for individuals aged 6 to 15 years) and 75% for students aged 16 and 17. The reason for this lower percentage is because teenagers are more likely to engage in other activities such as work or internship. Regarding health, pregnant women must perform prenatal care and pediatric follow-up to get the benefit.

When PBF beneficiaries fail to comply with obligatory conditions they are excluded since such conditionalities play a fundamental role in overcoming vulnerable situations. Keeping children in school and get higher educational level is the key to breaking the intergenerational cycle of poverty. However, the basic benefit that extremely poor families can receive does not require conditionalities.

Studies such as Banerjee and Duflo (2017) show that a small and low-cost incentive may imply significant benefits. Additionally, transfers can have a double role, acting directly in raising personal income and also as a stimulus for these families to observe their duties, granting program long-term goals achievement.

3 THE LITERATURE

A pioneering paper analyzing the PBF impact on education by Glewwe and Kassouf (2012) estimated models for school attendance and dropout rate, focusing on children from 1st to 8th grade, taking into account schools and municipalities, based on the school census from 1998 to 2005. Main results were that schools with beneficiaries have a higher enrollment and approval rate, and also a lower dropout rate. One of the most important findings in this work was that PBF exhibit cumulative effects over the years. Gender analysis revealed, on the one hand, the greater impact for girls on enrollment rate. On the other hand, boys presented better results for dropout rates.

The positive relationship between PBF and school enrollment rate is also analyzed by Melo and Duarte (2010), with a field survey carried out in 2005 in the states of Pernambuco, Ceará, Paraíba, and Sergipe, using PNAD microdata and the *Propensity Score Matching* method. This study focused on rural families who had agriculture as the household's main activity. It was found that a beneficiary child has a school enrollment rate 5.6 percent points (p.p.) higher than non-beneficiaries.

Breaking it down by gender, the results are similar to those observed in Glewwe and Kassouf (2012).

Romero and Hermeto (2009) analyzed the education impact on children from 7-14 years old, based on the PBF Impact Assessment Survey (AIBF) and CadÚnico. Results were significant, mainly on reducing school dropout rates for girls and increasing boys' approval.

The effects of PBF on school attendance of children aged 7-14 years were estimated for Silveira Neto (2010), using PNAD 2004 microdata and *Propensity Score Matching* method. Results pointed that a beneficiary is more likely to be attending school between 2.2p.p. and 2.9p.p. The impact is stronger in rural areas than in urban areas, corroborating the premise that PBF has greater effectiveness in regions considered to be poorer. This is confirmed by the Northeast results which had an impact of 3p.p. compared to 1.9p.p. of the Southeast region.

Using the same approach (PSM), Melo and Duarte (2010), in a field survey and the PNAD 2005 data, found significant results on increasing school attendance and also greater impact for girls. Santarrosa (2011) differs from other studies focusing on learning rates, using as reference the results of 2007 to 2009 *São Paulo Test* and CadÚnico data. Applying the dif-in-dif method, its main findings showed no impact on Portuguese and Mathematics proficiency.

In order to evaluate the effects of PBF transfers on educational outcomes from 2004 to 2006, Schaffland (2012) used PNAD data for both years and the PSM method. The educational results are limited to the enrollment rate and the average number of lost days during the week, which may have impacts not only for the benefit received but also for the conditionality of program, which requires minimum school attendance. Conclusions state that program beneficiaries are approximately 4% more likely to enroll in school and also have averages of lower absences than non-beneficiaries, expected result due to imposed conditionality. It is worthy of mention that PBF has a greater impact in the country's poorest regions, Northeast 5% and North 4%. While, rural areas have stronger impacts (5.5%) than urban ones (3.5%).

In order to investigate the PBF impacts on school attendance and age-series mismatch, Ribeiro and Cacciamali (2012) using the PSM method and 2006 PNAD performed their estimations. However, results indicated no significant differences between beneficiaries and non-beneficiaries, so the program effects didn't behave as expected.

Amaral and Monteiro (2013), concerned with school dropout, carried out research to try to capture the program effects on the same indicator. Applying the two editions of AIBF (2005 and 2009), and based on logistic models, the authors considered three income bands to compare data from the two data sources. The results indicate that a beneficiary has a lower chance of school dropout; moreover, the greatest impact is concentrated in those families that live in worse socioeconomic conditions.

Oliveira and Soares (2013)projeto frequência e censo escolar","publisher":"Texto para Discussão (IPEA performed a study based on data from CadÚnico, Project Frequency, and School Census, for the year 2008, estimating the PBF impact on school flow (repetition rate). At first, the intention was to run models only for the CadÚnico universe. The second part investigated the relationship between the benefit value and the author's expected impact. Finally, they observed differences between schools with/without any beneficiaries. In the first stage, they found that beneficiaries have a lower chance to repeat (11%) than the non-beneficiaries. Regarding transferred values, found that larger amounts do not imply impact differences; reaffirming that education conditionality is the variable that must have the greatest influence on educational outcomes. Moreover, schools with a higher proportion of beneficiaries are those with lower socioeconomic level.

Camargo and Pazello (2014), opposing Schaffland's (2012) qualitative indexes, evaluated the PBF impact on educational indicators regarding Brazilian schools, based on the Beneficiary's School Accountability Record and the School Census 2008 and the 2009 Brazil Test results, since there are no results for 2008. They found that increasing the number of beneficiaries per school reduces the approval rate and the average grades. Since, as a consequence of their socioeconomic conditions, these kids have lower school performance. On the other hand, the higher number of PBF participants reduces the dropout rate due to its conditionality.

Brauw *et al.* (2015) analyzed the PBF impact on educational indicators, dropout rates, approval and repetition rates, using AIBF I and II databases. They also applied the *Propensity Score Weighting* method comparing beneficiary families with those registered in the CadÚnico, but not beneficiaries. The results show that the PBF program works to increase the school enrollment probability. Considering children from 6-17 years, the impact was 4.5 percent, and the outcome is even greater when consider only those aged 15-17 years, with 7.3 percent. For other variables, significant results are only found after breaking by sex and by rural/urban area.

Silva, Cireno, and Proenca (2016) aimed to examine whether conditional transfers affect learning. The authors put together information from CadÚnico, School Census, and the Brazil Test, therefore providing characteristics for both students and schools. A differentiated method was tested, assuming possible data manipulation for those families that were close to the cutoff point (R$ 120.00). However, an unexpected change in the program eligibility line validated the method, whereas the manipulations would now occur close to the new program constraint, thereby validating the cutoff initially considered by the authors based on the discontinuity regression method. Thus, free from this issue, the authors concluded that PBF improves proficiency results to about 18% for Portuguese and 15% for Mathematics.

Recently, research performed by Kern, Vieira, and Freguglia (2017) tried to evaluate the PBF impact on schooling using indicators such as school enrollment rate, progression, repetition, and school dropout among children aged 6-17 years. They applied dif-in-diff method, in the same way as Santarrosa (2011), but with different data bases. In this case, they used AIBF (2005 and 2009), two rounds, comparing beneficiary families with those registered at CadÚnico but not beneficiaries, and not registered or benefited. Results showed that PBF boosts school enrollment in about 2.7%, and this impact rises to 7.41% when considering only the Northeast. Regarding school progression, results also pointed to an increase in these rates, but they only found statistically significant results in the 15-17 age group. In this case, they found an increase in the progression probability of 22.81% in the North/Central-West, 36.66% to the South/Southeast. Northeast presented an impact of 77.14% considering only rural area children. At last, the outcome pointed to a dropout rate reduction, but with the significant result only for the rural North/Midwest.

4 METHODOLOGY

4.1 Propensity Score Matching: sensitivity analysis

The PBF impact analysis, like any other public policy, is not a simple task due to the impossibility to observe the same individual in different situations (treated and untreated) before and after treatment. In virtue of PBF be non-experimental, a simple comparison between beneficiaries and non-beneficiaries generates a self-selection bias. Thus, the major challenge is to find the counterfactual, a control group which has the same beneficiaries' characteristics.

The Propensity Score Matching (PSM) method will be applied in this study. Developed by Rosenbaum and Rubin (1983), this method aims to solve the dimensionality problem for the set of observable indicators, seeking to synthesize the information contained in the variables that affect program participation.

$$ATT = E\{E\,[Y_{1i} \mid T_i = 1, P(x)] - E\,[Y_{0i} \mid T_i = 0, P(x)] \mid T_i = 1\} \quad (1)$$

It is observed that the Average Treatment Effects on Treated (ATT) is subject to the conditional probability of participating in the program P(x) or simply propensity score. T is a binary variable with 1 for treatment and 0 otherwise. Y_1 is the outcome with treatment (PBF) and Y_0 the outcome without treatment.

The considered hypotheses for better method formalization are:

1. Conditional Independence Assumption (CIA) - Given the set of controls of observed variables (X), the potential results are independent of PBF participation.
2. Overlap Condition or Common Support - At least one individual should be in the control

group for an individual in the treatment group, where 0 <P (x) <1.

There are several pairing ways to identify a good counterfactual. Hence, was chosen the nearest neighbor with substitution as the main algorithm. In order to find higher robustness to the results, it was applied complementary algorithms such as: Kernel, Caliper, Nearest Neighbor (NN) without substitution, NN with Caliper of 0.001, NN limiting the propensity score to the range of 0.5 to 0.95. It was also used the IPWRA - inverse probability weighted regression adjustment. Also, complementary estimations took into account different sample ranges, such as: income of R$140.00, parental educational variables, exclusion from other programs. However, results generally remained similar.

Since the PBF recipient's selection does not occur randomly, unobservable variables can affect the probability of participation. Therefore, Rosenbaum (2010) proposed a way of analyzing how influential an unobservable variable can be. For a better understanding of this idea consider that participation in the program is given by:

$$P_i = P(x_i, u_i) = P(T_i = 1 \mid x_i, u_i) = F(\beta x_i + \gamma u_i) \quad (2)$$

Note that the probability of participation is directly related to both observable (x_i) and unobservable variables (u_i). If $\gamma = 0$ means that the probability will depend only on the observables, but if $\gamma \neq 0$, two individuals with the same characteristics x_i will have different probabilities of participation (Becker and Caliendo, 2007).

Consider two individuals i and j where the participation odds are $\frac{P_i}{1-P_i}$ and $\frac{P_j}{1-P_i}$ respectively. The relational degree between them will be:

$$\frac{\frac{P_i}{1-P_i}}{\frac{P_j}{1-P_i}} = \frac{P_i(1-P_j)}{P_j(1-P_i)} = \frac{exp\ (\beta x_i + \gamma u_i)}{exp\ (\beta x_j + \gamma u_j)} \quad (3)$$

If i and j are identical in observables ($x_i = x_j$) then:

$$\frac{exp\ (\beta x_i + \gamma u_i)}{exp\ (\beta x_j + \gamma u_j)} = exp\ [\gamma\ (u_i - u_j)] \quad (4)$$

However, if there is a hidden bias ($u_i \neq u_j$) the unobservable characteristics will be influencing the results. Therefore, the Rosenbaum limits are expressed by:

$$\frac{1}{\Gamma} \leq \frac{P_i(1-P_j)}{P_j(1-P_i)} \leq \Gamma \quad (5)$$

Where $\Gamma = 1$ (no hidden bias) means that individuals i and j have the same participation odds to join the program. Thus, Rosenbaum's limits identify how much changes in Γ influence the results estimated by PSM. So, this test is applied for indicating the results robustness. As stated in Becker and Caliendo (2007) and, considering that our result variables are binary, the Mantel-Haenszel (MH) test is applied, focusing on the p_mh+ indicator which captures a possible PBF effect overestimation. All data treatment will be done using software STATA15.

4.2 The Data

To attain the research objective, the 2010 Brazilian Demographic Census was selected. The reason for this choice is justified by the greater data disaggregation possibility, since surveys such as PNAD have restrictions and a more superficial look, only by Brazilian states.

Northeast, being the country's poorest Region, becomes an interesting target to analyze the PBF impacts, but differently from other researches, this one will develop an analysis for all the states inside this Region, as well as for their respective mesoregions, in order to capture regional differences according to with peculiarities related to poverty and concentration, as mentioned before.

The sample comprises individuals from 6-17 years old, PBF beneficiaries, divided by groups (6-14 years and 15-17 years), characterizing the different Brazilian official educational stages: elementary and high school.

In order to search PBF eligible individuals, this article limited the sample to people with family *per capita* income no more than 60% of the minimum wage (<$ 306). This value above the eligibility line (R$140.00) seeks to control the cyclical nature of income, which at some point the poor family may receive more than the limit amount. Anyhow, tests with a cut based on the eligibility line of the PBF generally do not change the results.

The treatment variable will be measured by the benefit received by one of the child's family members, following a similar approach from

Cechin et al. (2015), in which PBF and Program for the Eradication of Child Labor (PETI) were separated based on the following facts: nonexistence of PETI in some municipalities; impossibility to be beneficiary of both programs at the same time; and the amount received by individuals can be compared to programs typical values. However, in situations where the typical values do not fit into these cases, children and youngsters will be classified as PBF beneficiaries. This decision follows the argument that PBF is far superior to PETI and, with very rare exceptions child would benefit from PETI. In any case, excluding non-typical values, as in Cechin et al. (2015), results generally are the same.

The education variables are summarized in Table I (enrollment rate and absence of age-grade gap). The decision to consider as lagged those with two or more years was taken, since in some cases (just birth date) make it difficult to identify the exact year lagged, consequently incurring in a possible classification error.

Table I – Dependent variables

Variable	Description
Enrolment rate (6-14)	The enrollment rate for children from 6 to 14 years old
Enrolment rate (15-17)	The enrollment rate for 15 to 17 years old
Age-grade gap (8-14)	School gap for children aged 8 to 14 years, considering that those with 2 or more years of delay are out of date
Age-grade gap (15-17)	School gap for young people aged 15 to 17, considering that those with 2 or more years of delay are out of date

Source: Elaborated by the authors.

Some limitations about these variables need to be underlined. Regarding school enrollment rate, it is only possible to know whether the student is enrolled during the research very moment but doesn't mean necessarily that he is attending school regularly. For age-grade gap, there is the only information available for those individuals who state that they are properly enrolled in school, and it is impossible to observe the delay of those who are not, which means that this variable analysis considers only enrolled individuals.

Seeking to capture the PBF effect on education with this model, control variables (individual, family, and household's characteristics) were used. These peculiarities are capable of influencing program participation as well as its impact. In this way the variables were: sex, age, race, natural logarithm of per capita family income, goods possession, dormitory density, household wall type, piped water, sewage, garbage collection, mother's education, mother's age, someone who receives retirement or pension in the household, someone in the household who receives money from some other kind of program, if the family is formed by a couple with children, area of residence and if they live in a state capital.

5 RESULTS

Firstly, this research analyses descriptive statistics as well as model adjustments, considering the need for common support and sample balancing after matching. In general, results indicated good adjustments. Some of the unsatisfactory balancing cases through nearest neighbor method occurred. However, similar impacts, but with better adjustment were found with alternative approaches (such as Kernel). Finally, the common support for total sample presented satisfactory adjustment, although it became more evident, limiting the sample to propensity scores of 0.5 and 0.95. Nevertheless, the results were not divergent when such limitation was made. All these cases will not be described here for lack of space. As an example, table AI in the appendix shows the average bias before and after of matching for Northeast states, a good adjustment with a mean bias above 5 for a wide majority, as the literature suggests (CALIENDO; KOPEINIG, 2008).

Therefore, Table II refers to the impact results for states of the Northeast region. There is a positive and significant effect on enrollment rates in both age groups and for all states. Among children (7 to 14 years old), the State of Alagoas has the greatest observed impact, since beneficiaries have a higher enrollment rate than non-beneficiaries from the counterfactual group, with an impact magnitude (ATT) of 4.94 percentage points (p.p.). Paraíba stands out for youths (15 to 17 years old), with 7.64p.p., which curiously was the state with the smallest effect for the children, with only 1.78p.p., Sergipe has the lowest impact (3.41p.p.) for those aged 15 to 17 years, hence, it's the only one with higher result for children (3.58p.p.) comparing to young people.

Table II – PBF Effect on educational indicators, enrollment rate and age-grade gap by states in the Northeast region

State	Enrolment rate		Age-grade gap	
	6-14 years	15-17 years	8-14 years	15-17 years
Alagoas	0.0494*** (0.0081)	0.0581** (0.0271)	0.0472*** (0.0170)	0.0180 (0.0225)
Bahia	0.0284*** (0.0028)	0.0520*** (0.0084)	0.0448*** (0.0078)	0.0330*** (0.0119)
Ceará	0.0269*** (0.0038)	0.0717*** (0.0137)	0.0205** (0.0090)	0.0443** (0.0192)
Maranhão	0.0302*** (0.0035)	0.0498*** (0.0114)	0.0312*** (0.0091)	0.0068 (0.0186)
Paraíba	0.0178*** (0.0038)	0.0764*** (0.0171)	0.0089 (0.0123)	0.0383** (0.0178)
Pernambuco	0.0318*** (0.0041)	0.0655*** (0.0142)	0.0354*** (0.0093)	0.0283 (0.0184)
Piauí	0.0218*** (0.0056)	0.0498** (0.0207)	-0.0142 (0.0148)	-0.0405 (0.0296)
Rio Grande do Norte	0.0302*** (0.0064)	0.0627*** (0.0180)	0.0476*** (0.0157)	0.0274 (0.0250)
Sergipe	0.0358*** (0.0082)	0.0341* (0.0182)	-0.0018 (0.0149)	0.0203 (0.0263)

Source: IBGE/Census (2010).
Notes: Generated with the nearest neighbor with replacement. ***, ** and * significance 1%, 5% e 10% respectively. Standard Errors between parentheses.

This difference according to the age group is explained because young people have a higher opportunity cost to enroll at the school, since they are more likely to join the labor market than been just beneficiaries of income transfers. As a result, these opportunity costs dropped but didn't vanish. Similar behavior was found in Brauw (2015), where the highest age group has approximately a 1p.p. difference comparing to the younger ones. As in Kern et al. (2017), the program has a greater impact for those aged 15 to 17 years.

In age-grade gap analysis, positive results were observed since a beneficiary is more likely to have no age-grade gap, but this variable showed up less statistically significant, especially for the 15 to 17 years age group.

Table III shows results for children, boys, and girls, from 6 to 14 years. Regarding enrollment rate, it is observed that results are slightly higher for boys, except in Sergipe, where the boy's impact (3.4 p.p.) is higher than girl's (2,56 p.p.). The greatest difference was found in Ceará, an ATT of 3.92 p.p. for boys, while only 2.31 p.p. for girls. As already exposed in table II, the state of Alagoas is the one with the highest PBF impacts on children enrollment rate, with 4.9 3p.p. and 4.66 p.p., for boys and girls respectively.

Regarding the age-grade gap, including only children aged 8 to 14 years, few results for boys were statistically significant. In this case, the enrollment rate equivalent behavior does not repeat since only girls have a significant impact in many cases. For the boys, the highest result appeared in Rio Grande do Norte, an impact of 7 p.p. (not having an age-grade gap among enrolled children), for girls, Alagoas stood out with 5.49 p.p.

Table III – The PBF effect on educational indicators, enrollment rate and age-grade gap of children (7-14 years) from Northeast – Gender

State	Boys		Girls	
	Enroll-ment rate	Age-grade gap	Enroll-ment rate	Age-grade gap
Alagoas	0.0493*** (0.0080)	0.0419* (0.0229)	0.0466*** (0.0108)	0.0549*** (0.0212)
Bahia	0.0297*** (0.0041)	0.0412*** (0.0105)	0.0264*** (0.0038)	0.0414*** (0.0105)
Ceará	0.0392*** (0.0059)	0.0018 (0.0137)	0.0231*** (0.0056)	0.0143 (0.0143)
Maranhão	0.0341*** (0.0058)	0.0161 (0.0148)	0.0318*** (0.0049)	0.0365*** (0.0131)
Paraíba	0.0259*** (0.0064)	-0.0056 (0.0167)	0.0248*** (0.0063)	0.0507** (0.0199)
Pernam-buco	0.0372*** (0.0066)	0.0143 (0.0125)	0.0244*** (0.0048)	0.0308** (0.0121)
Piauí	0.0157** (0.0073)	0.0155 (0.0209)	0.0091* (0.0055)	0.0148 (0.0229)
Rio Grande do Norte	0.0316*** (0.0080)	0.0760*** (0.0201)	0.0241*** (0.0079)	0.0442** (0.0186)
Sergipe	0.0256** (0.0103)	-0.0085 (0.0207)	0.0348*** (0.0097)	0.0276 (0.0288)

Source: IBGE/Census (2010).
Notes: Generated with the nearest neighbor with replacement. ***, ** and * significance 1%, 5% e 10% respectively. Standard Errors between parentheses.

In Table IV, again the results by gender are exhibited, but just for the group from 15 to 17 years. These impacts are generally bigger because of the higher opportunity cost to come back to school or even to be focused exclusively on this activity. Similarly, to the data from children, boys have higher effects than girls for enrollment and the reverse for the age-grade gap. For instance, results for enrollment, in general, are all significant at 10% for boys, having no significant impact on girls in three states. However, the age-grade gap had no significant impact on boys, but the effect was statistically significant for girls in five states.

Therefore, in both age groups, it is observed that the PBF had a greater impact on the enrollment rate for boys. On the other hand, Melo and Duarte (2010) found higher impacts for girls. However, the present study results can be explained by the fact that independently of PBF, girls are more likely to enroll. Hence, the effect becomes greater for boys, where the incentive is fully functional. For the age-grade gap, the impacts are less clear, sometimes significant for girls in a few states.

Table IV – PBF Effect on educational indicators, enrollment rate and age-grade gap of young people (15-17 years) from Northeast – Gender

State	Boys		Girls	
	Enrollment rate	Age-grade gap	Enrollment rate	Age-grade gap
Alagoas	0.0370* (0.0205)	-0.0808** (0.0378)	0.0350 (0.0276)	0.0749** (0.0361)
Bahia	0.0619*** (0.0115)	-0.0197 (0.0162)	0.0471*** (0.0154)	0.0713*** (0.0222)
Ceará	0.0954*** (0.0186)	0.0227 (0.0274)	0.0148 (0.0133)	0.0774*** (0.0279)
Maranhão	0.0473*** (0.0178)	-0.0216 (0.0255)	0.0589*** (0.0187)	0.0552** (0.0243)
Paraíba	0.0392* (0.0204)	0.0190 (0.0197)	0.0439* (0.0260)	0.0104 (0.0353)
Pernambuco	0.0690*** (0.0202)	0.0152 (0.0253)	0.0527*** (0.0156)	0.0674*** (0.0245)
Piauí	0.0743** (0.0353)	-0.0736 (0.0506)	0.0750*** (0.0272)	0.0004 (0.0491)
Rio Grande do Norte	0.0811*** (0.0262)	0.0422 (0.0293)	0.0323 (0.0261)	0.0129 (0.0469)
Sergipe	0.0971*** (0.0375)	-0.0154 (0.0385)	0.0683** (0.0284)	-0.0031 (0.0424)

Source: IBGE/Census (2010).
Notes: Generated with the nearest neighbor with replacement. ***, ** and * significance 1%, 5% e 10% respectively. Standard Errors between parentheses.

The results in Table V are equivalent to those already made, but now, for children (7 to 14 years) of rural and urban areas. A PBF positive effect on the enrollment rate stands, and some significant impacts for the age-grade gap as well. Because of its worse educational indicators, the rural area presents bigger effects than urban one. Schaffland (2012) moreover, Silveira Neto (2010) also found a PBF strong impact on rural education indicators.

Regarding enrollment rate, the bigger difference is in Sergipe, while a beneficiary in the rural area has the PBF impact of 6.65 p.p., for the urban area this value drops to 1.92 p.p. It doesn't mean that PBF has no effect in urban areas, but because there is a much higher enrollment rate, the program impact in the rural area becomes most important. Likewise, the results for age-grade gaps are only significant for some states, for both rural and urban areas.

Table V – PBF Effect on educational indicators, enrollment rate and age-grade gap of children (7-14 years) from the Northeast - Residence Area

State	Urban		Rural	
	Enroll-ment rate	Age-grade gap	Enroll-ment rate	Age-grade gap
Alagoas	0.0251*** (0.0075)	0.0148 (0.0190)	0.0342*** (0.0098)	0.0585** (0.0247)
Bahia	0.0181*** (0.0027)	0.0310*** (0.0078)	0.0282*** (0.0046)	0.0477*** (0.0126)
Ceará	0.0241*** (0.0040)	0.0160 (0.0104)	0.0308*** (0.0071)	0.0221 (0.0171)
Maranhão	0.0311*** (0.0051)	0.0273** (0.0116)	0.0292*** (0.0053)	0.0325** (0.0151)
Paraíba	0.0185*** (0.0046)	0.0197 (0.0151)	0.0266*** (0.0078)	0.0277 (0.0230)
Pernam-buco	0.0307*** (0.0039)	0.0355*** (0.0091)	0.0333*** (0.0072)	0.0309* (0.0170)
Piauí	0.0127** (0.0050)	-0.0065 (0.0161)	0.0226*** (0.0071)	-0.0214 (0.0259)
Rio Grande do Norte	0.0179*** (0.0044)	0.0430** (0.0172)	0.0275*** (0.0089)	0.0692*** (0.0268)
Sergipe	0.0192*** (0.0057)	0.0125 (0.0184)	0.0665*** (0.0070)	-0.0747*** (0.0289)

Source: IBGE/Census (2010).
Notes: Generated with the nearest neighbor with replacement. ***, ** and * significance 1%, 5% e 10% respectively. Standard Errors between parentheses.

As seen in previously recorded results regarding youngsters in Table VI, it is observed a stronger impact on the enrollment rate for this age group. Rio Grande do Norte and Alagoas urban areas and Ceará rural area had major impacts exceeding 10p.p.

Comparing urban and rural differences, there is huge heterogeneity in rural areas, where non-significant results appeared in four of nine states.

For the age-grade gap, results show little evidence of PBF impact on teenagers.

Considering Brazil's high heterogeneity, this paper also aims to capture possible impact differences within a specific state. In order to achieve this purpose, some tools were used, like data disaggregation, considering 42 mesoregions inside Northeast region. According to Figure I, the results are more consistent for individuals from 6 to 14 years, but the age range of 15 to 17 years have stronger impacts. This behavior was already detected in the state, gender and residence area analysis. Mesoregions which had the greatest impact for children were *Leste Alagoano*, *Agreste Pernambucano*, and *Sertão Sergipano*, with 5.31 p.p., 5.58 p.p., and 7.16 p.p. respectively, and for teenagers, *Agreste Pernambucano* (12,25p.p.) and *Agreste Potiguar* (18.34 p.p.).

It is important to realize that all the so-called "significant" results showed positive PBF impacts by increasing school enrollment. However, despite the strong impact for teenagers from 15 to 17, in this age group, it has greater heterogeneity among mesoregions since only 6 mesoregions do not have significant PBF impact on this variable for children. For teenagers that number was 25 mesoregions (non-significant impact); indicating that the enrollment problem for this age range remains a challenge.

Figure II shows the results for the age-grade gap, which had few significant results, mainly for the age group of 15 to 17 years.

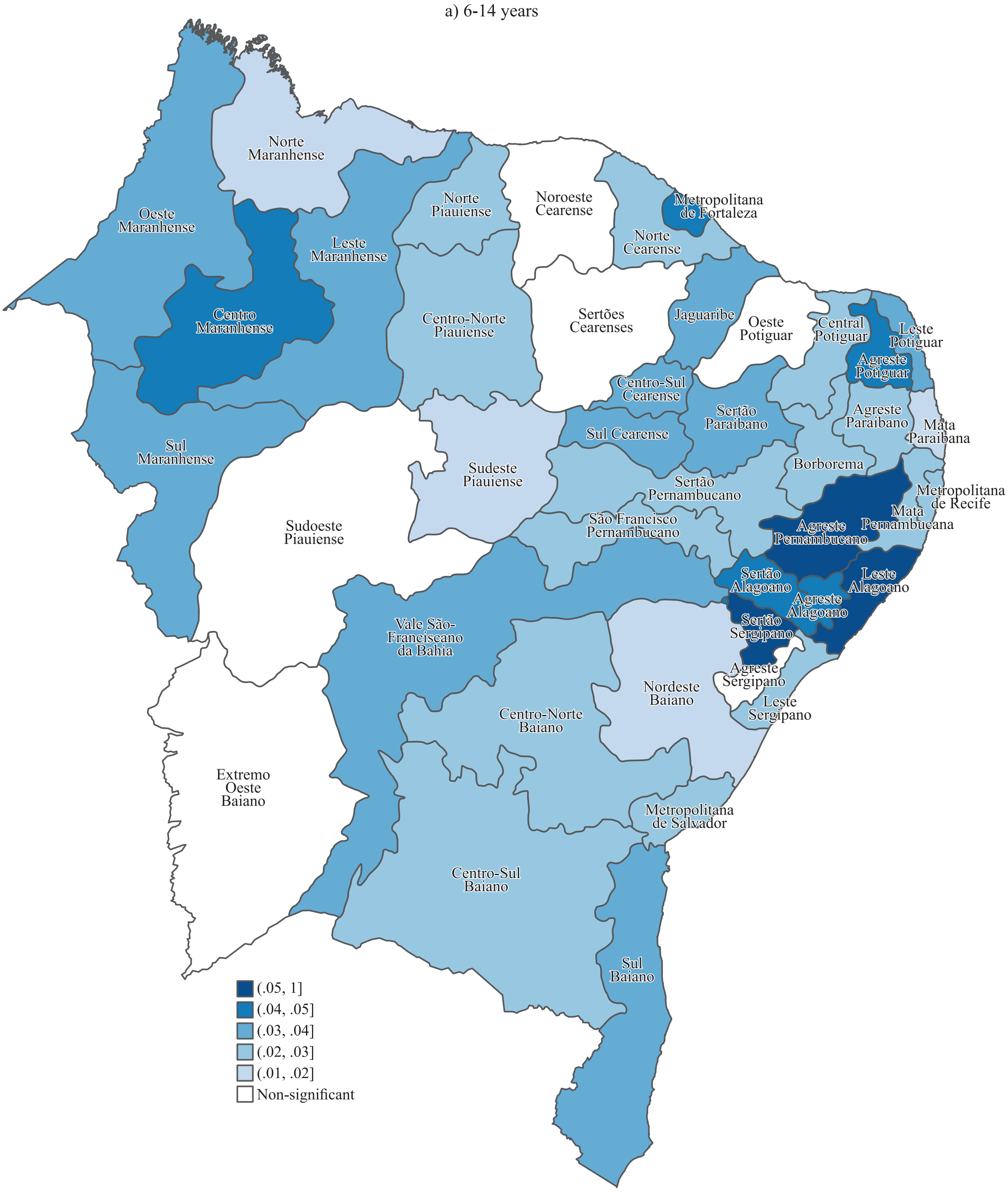
Table VI – PBF effect on educational indicators, enrollment rate and age-grade gap of youngsters (15 to 17 years) from Northeast - Area of Residence

Estado	Urban		Rural	
	Enroll-ment rate	Age-grade gap	Enroll-ment rate	Age-grade gap
Alagoas	0.1087*** (0.0324)	-0.0227 (0.0285)	0.0121 (0.0430)	0.0318 (0.0340)
Bahia	0.0570*** (0.0095)	-0.0075 (0.0147)	0.0387*** (0.0118)	0.0139 (0.0215)
Ceará	0.0591*** (0.0139)	0.0252 (0.0174)	0.1024*** (0.0226)	0.0079 (0.0306)
Maranhão	0.0737*** (0.0196)	-0.0267 (0.0264)	0.0467*** (0.0175)	0.0073 (0.0270)
Paraíba	0.0407** (0.0159)	0.0265 (0.0217)	0.0831*** (0.0280)	0.0578* (0.0304)
Pernambuco	0.0419*** (0.0134)	0.0112 (0.0171)	0.0777*** (0.0220)	0.0743** (0.0347)
Piauí	0.0736*** (0.0238)	0.0353 (0.0229)	0.0190 (0.0276)	-0.1162*** (0.0430)
Rio Grande do Norte	0.1093*** (0.0204)	0.0304 (0.0246)	0.0211 (0.0203)	-0.0083 (0.0542)
Sergipe	0.0767*** (0.0199)	0.0206 (0.0277)	0.0393 (0.0269)	-0.0032 (0.0452)

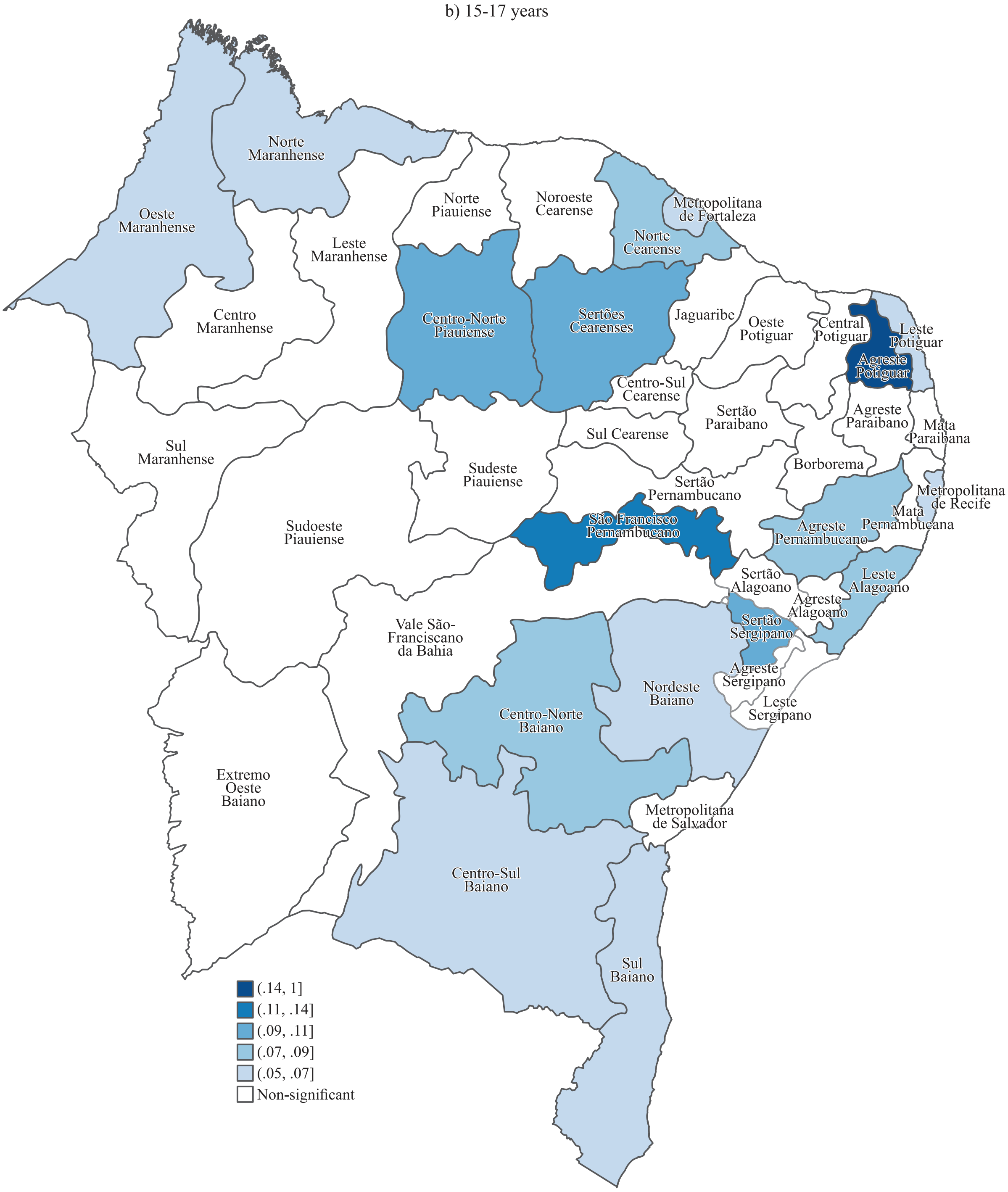
Source: IBGE/Census (2010).
Notes: Generated with the nearest neighbor with replacement. ***, ** and * significance 1%, 5% e 10% respectively. Standard Errors between parentheses.

Figure I – Distribution of PBF impacts on the enrollment rate of northeastern mesoregions

a) 6-14 years



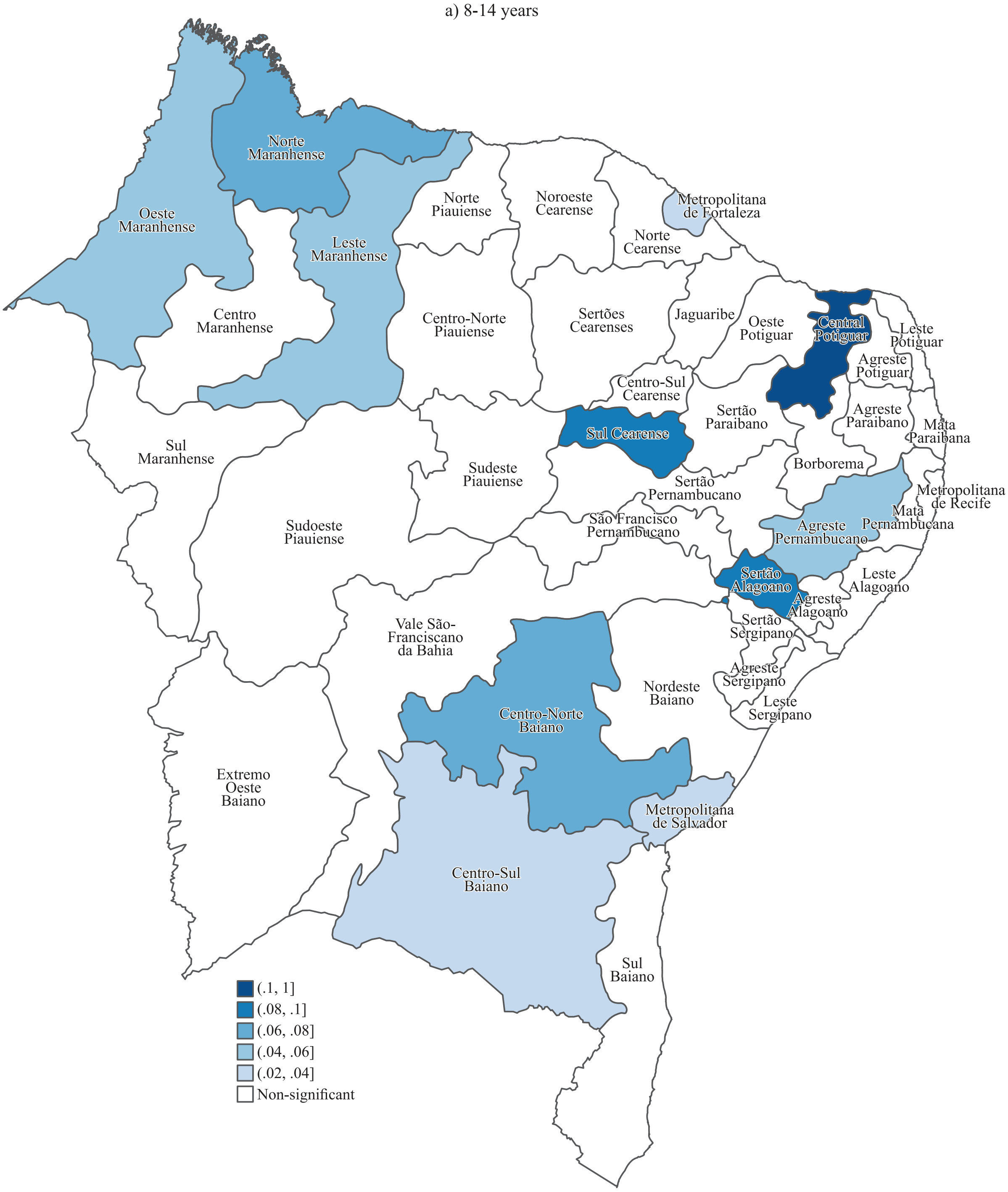
b) 15-17 years



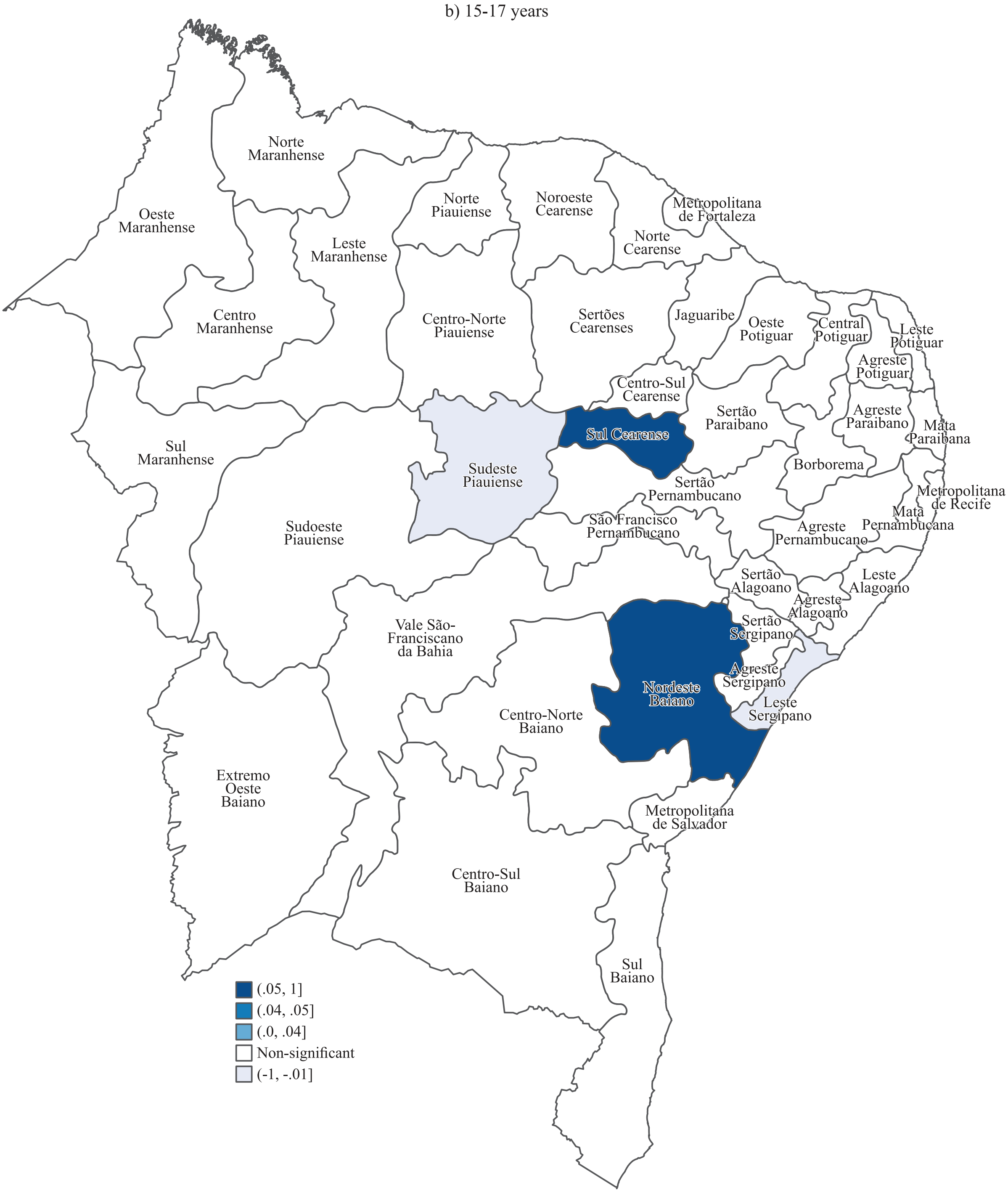
Source: Author's own elaboration based on the estimates made.
Notes: Generated with the nearest neighbor with substitution.

Figure II – Distribution of PBF impacts on age-grade gap of northeastern mesoregions

a) 8-14 years



b) 15-17 years



Source: Author's own elaboration based on the estimates made.
Notes: Generated with the nearest neighbor with substitution.

In order to get more reliability, these maps were plotted, using kernel method. The main conclusions remained, but the significant results raise, mainly for the enrollment rate of teenagers from 15 to 17 years. In this case, was found significant impact for 27 mesoregions (see Figure A1 and Figure A2).

As robustness on methodology were applied algorithms and samples considering inclusion and exclusion of variables and different income perspectives, finding similar results.

Table VII presents the Rosenbaum sensitivity analysis, providing robustness in the sense of the hidden bias problem, which in this case was delimited to the general results presented in Table II.

Initially was found that enrollment rate results are the more robust. For children enrollment rate from 6 to 14 years, the lowest critical value Γ goes to the state of Paraíba, being 1.5 or 1.6, depending on the level considered. This means that the results could be questionable when a variable omitted could affect program participation, and this variable also responds by 1.6 times to differ in odds of receiving the PBF of two individuals with the same observable characteristics ($x_i = x_j$). Thus, the difference in PBF participation would be partially attributed by non-observable variables. Results for the age-grade gap are not robust due to the possibility of omitted variables which indicates that the effects could be questionable. Moreover, for the age-grade gap, as previously described, the impact is not so clear, and there are many cases with non-statistically significant effects.

Table VII – Rosenbaum Sensitivity Analysis for the Northeastern States

State	Gamma							
	Enrollment rate				Age-grade gap			
	6-14 years		15-17 years		8-14 years		15-17 years	
	>0.05	>0.10	>0.05	>0.10	>0.05	>0.10	>0.05	>0.10
Alagoas	1.7	1.8	1.1	1.1	1.1	1.1	NS	
Bahia	2.1	2.2	1.5	1.5	1	1	1	>5
Ceará	2.3	2.4	1.5	1.5	1.1	1.1	1	>5
Maranhão	2.3	2.4	1.8	1.8	1.1	1.1	NS	
Paraíba	1.6	1.7	1.3	1.4	NS		1	1
Pernambuco	2.4	2.5	1.4	1.4	1.1	1.1	NS	
Piauí	1.8	1.9	1.1	1.1	1.1	1.1	NS	
Rio Grande do Norte	2.3	2.4	1.4	1.4	1.1	1.1	NS	
Sergipe	1.6	1.7	1.3	1.4		NS	NS	

Source: Author's elaboration based on IBGE Census (2010)
Notes: Generated with the nearest neighbor with replacement. NS = non-significant results according to Table 1.

6 CONCLUSION

This research aimed to examine the PBF impact on educational indicators (enrollment rate and age-grade gap), of children and teenagers from 6 to 17 years, in the Northeast region. Taking into account the program conditionality directly related to education. The study distinction is the estimation for all Northeast states and their respective mesoregions since the literature focuses mainly on general analysis for Brazil or macro-regions. In this way, it was discussed the possibility of heterogeneity and regional specificities in a more disaggregated way.

From a methodological point of view, the impossibility of observing the same individual in a beneficiary and the non-beneficiary situation required a strategy for a good control group construction, which could be solved through *Propensity Score Matching* method. The average effect for treatment estimation was based on the *nearest neighbor* approach with substitution and, in order to achieve better robustness results, other algorithms like *Caliper*, *Kernel* and the *nearest neighbor* itself were used without replacement. Likewise, additional estimations and Rosenbaum limits analysis were performed. Furthermore, data provided by the 2010 Census were used.

The models, firstly estimated for all Northeast states, confirmed the PBF positive impact on educational indicators with an emphasis on enrollment rate. It was possible to determine some variation on the effects among the states, for instance, the state of Alagoas which stressed itself for the enrollment rate for children from 6 and 14 years old. For the age range from 15 to 17, it was observed that the PBF has stronger effects, especially in Paraíba. It is important to emphasize that the significant effects in this age range may be because children from 6 to 14 years have the lower opportunity cost of attending school and consequently have higher enrollment rates. About enrollment rate, all the results were statistically significant for all states. However, the non-significant results were found for age-grade gap (mainly for teenagers).

When these results were separate by gender, the program generally shows a greater impact on boy's enrollment rate (for similar reasons to the impact difference between children and young people), since girls naturally have higher enrollment rates. The impact differences still remain when data was disaggregated by residence area, since was noticed that rural area beneficiaries perform more expressive results comparing to urban ones, in spite of the rural heterogeneity when we consider the age range of 15 to 17 years.

Considering the results by mesoregions - the main differential in this research - some statements must be made. Firstly, regarding enrollment rate, not all the results are statistically significant, showing impact heterogeneity, similarly to the analysis by states for the age range 15 to 17 years. For this age range, despite relatively stronger impacts after mesoregion disaggregation, the number of non-significant analyzes increased, indicating that in spite of some PBF impact, the "staying on school" opportunity cost for teenagers remain high even with money assistance.

It is important to stress that PBF does not aim, and cannot solve, educational problems, so adequate educational policies seem crucial in order to get better indicators. In other words, the program works as an incentive for children and youngsters to stay in school, but especially for this last age group and those living in rural areas there is a massive challenge. Educational policies that enhance both quantity and quality of education are imperative.

One of the work's limitations is the use of only quantitative indicators, leaving open conclusions regarding school quality. However, future research may fill this gap, as well as updating these results, using the new Demographic Census planned for 2020.

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APPENDIX

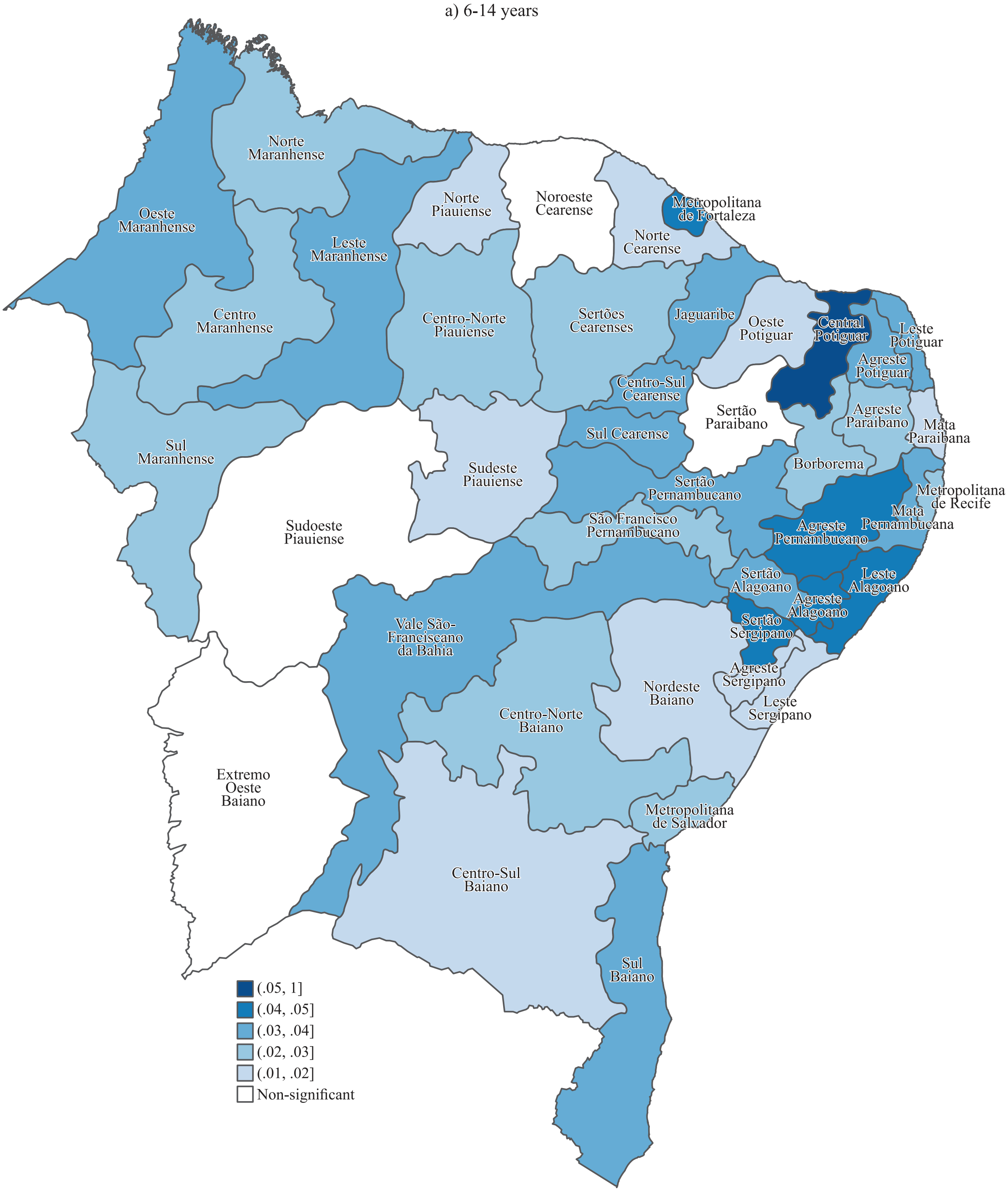
Table A1 – Mean bias

State	Situation	Enrolment rate		Age-grade gap	
		6-14 years	15-17 years	8-14 years	15-17 years
Alagoas Bahia	Unmatched	23.6	24.3	24.3	24.9
	Matched	3.6	6.0	4.0	7.3
Ceará Maranhão	Unmatched	24.0	24.0	24.8	24.7
	Matched	2.8	2.8	3.1	3.8
Paraíba Pernambuco	Unmatched	25.9	25.0	26.3	25.6
	Matched	2.8	3.7	2.9	3.0
Piauí Rio Grande do Norte	Unmatched	21.9	22.8	22.7	23.7
	Matched	2.1	3.2	2.5	3.7
Sergipe Alagoas	Unmatched	23.5	24.2	23.9	24.6
	Matched	3.1	4.9	2.9	4.5
Bahia Ceará	Unmatched	22.2	23.4	23.2	24.9
	Matched	2.8	3.0	2.8	4.7
Maranhão Paraíba	Unmatched	26.6	25.1	27.2	26.1
	Matched	4.4	5.3	4.1	4.3
Pernambuco Piauí	Unmatched	23.6	23.3	24.0	23.7
	Matched	3.8	4.3	4.4	5.6
Rio Grande do Norte	Unmatched	23.7	24.3	24.5	25.5
	Matched	2.5	2.8	3.0	3.5

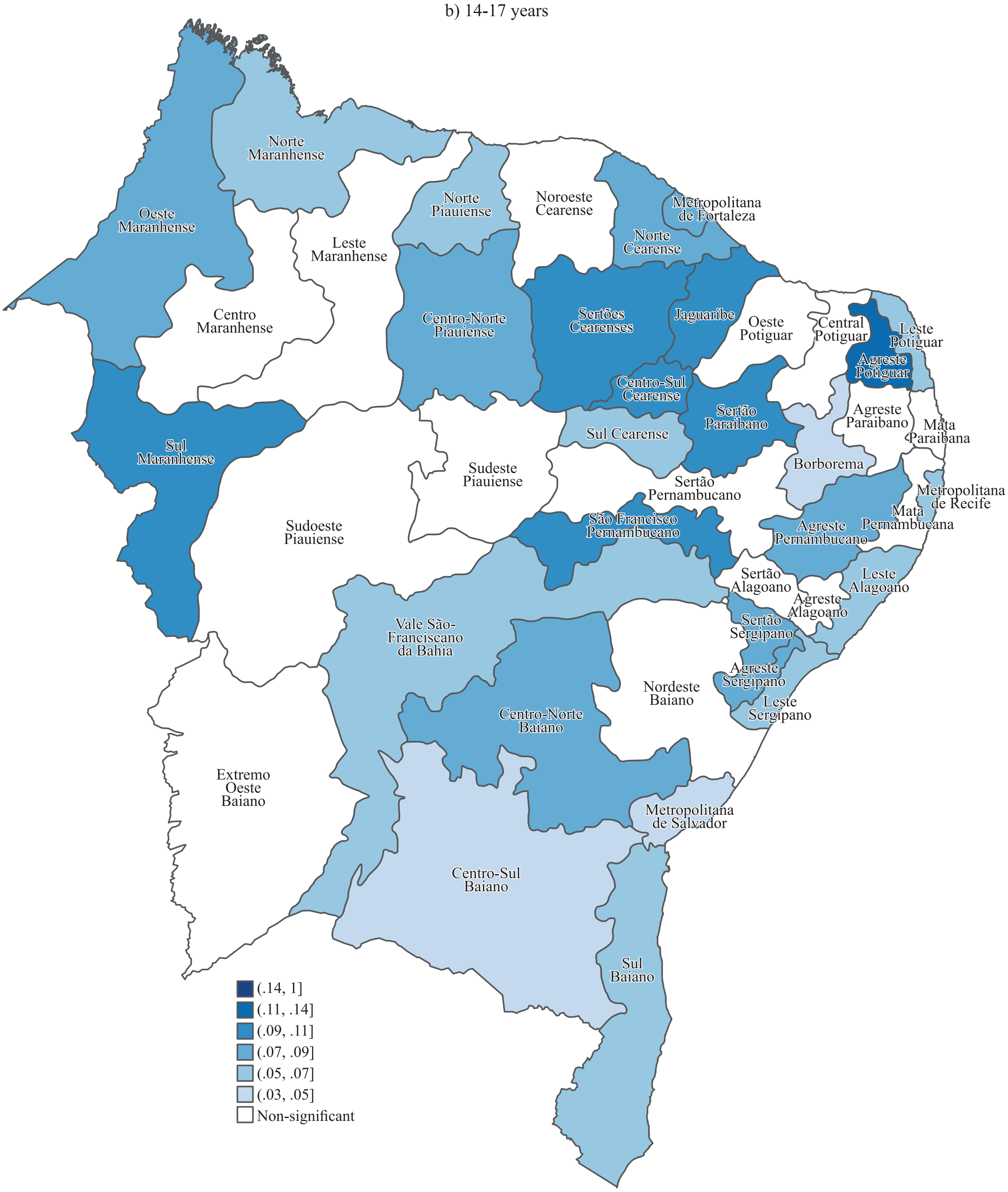
Source: Author’s own elaboration based on the estimates made.
Notes: Generated with nearest neighbor with replacement.

Figure AI – Distribution of PBF impacts on the enrollment rate of northeastern mesoregions (Kernel)

a) 6-14 years



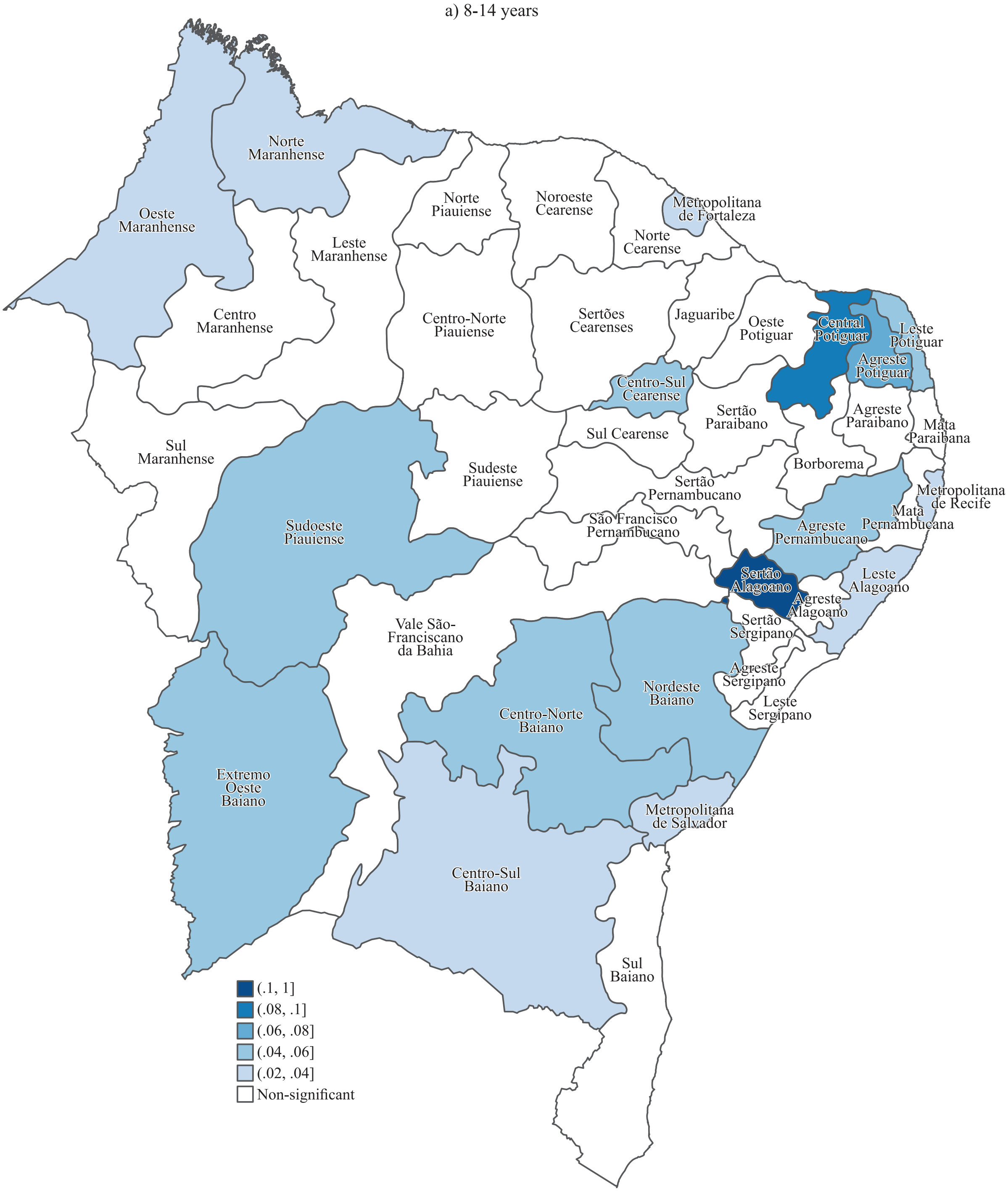
b) 14-17 years



Source: Author's own elaboration based on the estimates made.
Notes: Generated with Kernel.

Figure AII – Distribution of PBF impacts on age-grade gap of northeastern mesoregions (Kernel)

a) 8-14 years



b) 15-17 years

Source: Author’s own elaboration based on the estimates made.
Notes: Generated with Kernel.