Race-based affirmative action for higher education in Brazil: impact assessment on performance, time and delay in completion

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Abstract

This paper aims to investigate the impact of the race-based affirmative action for higher education in Brazil on academic performance, time and delay in completion. For that, all public Higher Education Institutions (HEIs) in Brazil were analyzed and the data used were obtained by the survey of the National Student Performance Examination (Enade) in the period from 2016 to 2018. Through the propensity score matching methodologies, entropy balancing, empirical quantile regression strategy and Lewbel method, a statistically significant negative impact, although small, on students' performance was observed. However, the estimates by the Lewbel method highlight a possible underestimation of the results when unobservable characteristics of the students are not analyzed. Significant effects on time and delay in completion were not found in most of the estimators used.

Keywords: Racial Quotas. Higher Education. Brazil.
JEL Classification: I21, I23, D63, C21.
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Resumo

O objetivo do estudo é analisar o impacto das ações afirmativas raciais para o ensino superior no Brasil sobre o desempenho acadêmico, o tempo e o atraso na conclusão do curso. Para tanto, foram analisadas todas as Instituições de Ensino Superior (IES) públicas do Brasil e os dados utilizados foram obtidos pelo questionário do Exame Nacional de Desempenho dos Estudantes (Enade) no período de 2016 a 2018. Por meio das metodologias de propensity score matching, pareamento por entropia, efeito do tratamento quantílico e método de Lewbel, observou-se impacto negativo estatisticamente significativo, embora pequeno, no desempenho dos alunos. No entanto, as estimativas pelo método de Lewbel evidenciam uma possível subestimação dos resultados quando não são analisadas características não observáveis dos alunos. Não houve resultados significativos no tempo ou no possível atraso na conclusão do curso na maioria dos estimadores utilizados.

Palavras-Chave: Cotas raciais. Ensino Superior. Brasil.
Classificação JEL: I21, I23, D63, C21.
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1. Introduction

Affirmative action for admission to higher education is a common practice around the world, and its importance for the inclusion of minority groups in higher education is a research subject in different countries. This type of policy is the subject of discussions and divisions that can have strong social and economic implications. If on the one hand it is argued that these measures would be necessary for a historical reparation of social injustices (Kane, 1998; Francis & Tannuri-Pianto, 2012), on the other, its efficiency is disputed to the extent that students admitted through the quota system would not be able to reduce the schooling gap, which could even compromise the quality of education (Sowell, 2004).

In Brazil, higher education is characterized by asymmetries in access and permanence, which reflect the socioeconomic inequalities existing in Brazilian society. In example, according to data

from the Brazilian Institute of Geography and Statistics (IBGE), the proportion of 18- to 24-year-olds of white color or race who were attending or had already completed higher education in 2018 was 36.1%, while the same proportion of the black population was only 18.3% (IBGE, 2018).

Aiming to reduce social inequalities in access to this level of education, the first national experiments with affirmative action occurred on a voluntary basis at institutions such as the State University of Rio de Janeiro (UERJ), the North Fluminense State University Darcy Ribeiro (UENF), and the University of Brasília (UnB). The mandatory implementation of the quota system for admission into higher education came about through Law No. 12,711 of August 29, 2012, which provides for admission into federal universities and federal educational institutions (BRASIL, 2012). From this moment on, all federal higher education institutions (HEIs) should have in their calendar the reservation of seats for the different pre-defined criteria, which involve color/race, family income, and completion of high school in public schools.

Since the quotas implementation in Brazil, the policy has been the subject of divisions on its benefits (Bailey & Peria, 2010). The criticism about a possible decrease in the quality of education gained notoriety to the extent that students who opted for admission via the reserved seats system, in theory, would have a lower performance in the admission exam and throughout the undergraduate program - thanks to the disparities and deficiencies in basic and secondary education - and, thus, would face difficulties in "keeping up" with those who were admitted via the universal system. In addition, these students, due to the worse socioeconomic and school conditions they might be inserted in, would also tend to drop out more or take longer to graduate, either due to a greater difficulty in passing single courses or having to divide their time between work and study, which would compromise their dedication to the undergraduate program (Wainer & Melguizo, 2018).

The national literature does not point to a consensus on the effects that the quota policy has on students' academic performance. In an analysis at UnB, Cunha (2006) and Francis and Tannuri-Pianto (2012), found no statistically significant differences in performance between quota and non-quota students. Pinheiro (2014), in turn, found significant differences at the Federal University of Espírito Santo (UFES), as did Silva et al (2020) at the Federal University of Paraíba (UFPB).

The present study seeks to contribute to this discussion and verify, based on data from the National Exam of Students Performance (Enade) from 2016 to 2018, the impact of affirmative policies on the performance of students at Brazilian public HEIs. We point out that the impact assessment of affirmative action policies is mostly found in the international context, especially in the U.S. analysis, and it is still not trivial in the country, especially in analyses that consider the entire national territory. In this same approach for Brazil, there is the study by Vidigal (2018), which assessed the policy's impact on all Brazilian universities.

Aiming to advance in the debate, this study also aims to assess the policy's impact on the completion time and delay of students who took the Enade during the observed period, an unprecedented assessment of this policy in the national context. Thus, we expect that it will be possible to fill this gap in the national literature, because understanding how the groups of quota and non-quota students behave during higher education is of great relevance for educational public policy managers. Since affirmative action was not created to be permanent, it is necessary to frequently assess the policy to check its effects and possible needs for reformulation so that it can best achieve its objectives.

To accomplish the proposed objectives, we estimated the average treatment effect on the treated (ATT) using propensity score matching and entropy matching techniques, which use the students' observable characteristics to construct a counterfactual in the control group. As an additional strategy, we also used the quantile treatment to deal with possible divergence along the distribution and the Lewbel (2012) method to try to deal with possible selection bias in students' unobservable characteristics, which may affect the probability of participating in affirmative action.

The study is organized in sections. Besides this introductory section, the second section includes the literature review on the subject. The third section presents the empirical strategies adopted, as well as the data we used. The results we obtained with the research are in the fourth section and, finally, in the fifth section, the final considerations on the study.

2 Literature Review

2.1 Effects of affirmative action on inclusion and academic performance

The role of affirmative action for the inclusion of minority groups in higher education is already known in the literature. In the United States, specialized literature has sought to analyze the effects of the absence of policy on the admission and participation of underprivileged groups in different undergraduate programs (Epple et al., 2008; Hinrichs, 2010; Howell, 2010; Blume & Long, 2014).

The U.S. research results point to the need for the permanence of affirmative action for a greater access equality. Hinrichs (2010), when estimating the effects of banning the policy on enrollment, performance, and demographic composition at the University of California, found that proscribing the policy decreases underrepresented minority participation and increases the participation of the already white majority in the programs. The results were in line with the findings of Epple et al (2008), in an analysis of the consequences of banning affirmative action in higher education institutions in the country. Howell (2010) noted that without race-based affirmative action, minority representation in higher education admissions at selected institutions would be about 10% lower. The U.S. literature also points to the greater probability of racial minorities being admitted to more prestigious universities thanks to affirmative action (Long, 2004; Arcidiacono, 2005).

In India, Bertrand et al. (2010) and Robles and Krishna (2012), respectively, have analyzed that affirmative action has positive implications on the labor market outcomes of the policy's target audience and that the policy effectively targets students from groups considered to be poorer minority ones. Also, in the Indian context, Bagde et al (2016) evidenced that affirmative action has increased the enrollment of students from the so-called underprivileged castes. However, one problem, with regard to this policy in India, was the association with a reduction in female enrollment, which may indicate differences in the gender gap between families of different castes (Bertrand et al, 2010; Cassan, 2019).

In the Brazilian context, most of the studies on the subject are restricted to empirical research of specific universities. Results, on average, indicate that the policy increases the enrollment of underprivileged students in the targeted group (Francis & Tannuri-Pianto, 2012; Bayma, 2012; Estevan et al, 2018). However, Lopes (2017) found that students who are admitted via affirmative action policies often enroll in less prestigious programs at universities.

Recently the study by Vieira and Arends-Kuenning (2019) sought to analyze how affirmative action has affected the enrollment of students from minority groups in Brazil. The study's results pointed to a policy’s positive effect on this group of students' enrollment, especially black students. We also observed that the specificity of the racial-ethnic criteria in the quotas influences the participation of black people in higher education, to the extent that universities that have used the quota policy without explicit racial criteria have not had significant changes in their students' racial profile.

There are not yet many analyses of the policy's effects on students' academic performance in the national context. First of all, it is important to point out that admission via affirmative action cannot be considered an academic performance determinant. In this case, what may happen is an influence on performance due to socioeconomic conditions, in which those admitted via this modality may be inserted, and the quality of their previous educational background. According to Wainer and Melguizo (2018), the fact that quota students are likely to have worse socioeconomic and educational conditions could interfere with their performance. Moreover, as these students may be more likely to face difficulties to support themselves during higher education, having to split time between studies and work, they would tend to be more likely to drop out or delay completion.

Although most of the literature assessing the impact of affirmative action on performance is focused on the United States' case, an example of research in a developing country is the study by Frisancho and Krishna (2012), which assessed the impact of affirmative action on an undergraduate

engineering class in India. The authors found a lower performance of minority group students compared to the same peers as they progress through college.

In the national context, the specific use of impact assessment methodologies to analyze the policy is still low. Most of the literature aimed at analyzing the effects of affirmative action policies for higher education on academic performance uses other tools that do not allow capturing the average treatment effect. For example, Cunha (2006) when studying the performance of quota and non-quota students at the University of Brasilia (UnB) found a higher performance of those admitted by the universal system compared to quota students. This result was mainly in the programs concentrated in the Science area. Cardoso (2008), also analyzing the quota policy at UnB, found that quota and non-quota students have similar performance. However, the author found lower performance for those admitted via the quota system in the more prestigious Science programs.

Pinheiro (2014) found differences in performance between quota and non-quota students in engineering programs at the Federal University of Espírito Santo, especially in calculus and algebra courses. In the Economic Sciences and Computer Sciences programs, the author also found statistically significant differences between the quota students when dividing them by gender. In this case, the female quota students' performance was higher than that of the male students. Meanwhile, Tresoldi et. al (2014), when conducting an analysis in the most competitive undergraduate programs at the Federal University of Rio Grande do Sul, found no significant differences in performance between quota and non-quota students in the medical undergraduate program, however, the author observed differences in the engineering programs.

Childs and Stromquist (2014) focused their study on three Brazilian universities and the results pointed out that the performance of quota students is satisfactory and does not reduce the institutions' quality. Queiroz et. al (2015) found no statistically significant differences in performance between those who were admitted via broad competition and those who were admitted via the quota system at the Federal University of Uberlândia.

Among the works that have assessed the policy's impact in the national context are the studies by Francis and Tannuri-Pianto (2012), who based their analysis on UnB, and Vidigal (2018), a pioneer in assessing the policy's impact on all Brazilian universities. The studies' results pointed out that the quota policy does not decrease the students' performance.

As it can be seen in this section, the relationship between admission via affirmative action policy/quotas and the students' academic performance is not an academic consensus.

In view of this, this paper seeks to contribute to the debate by analyzing the impact on the academic performance of students who undertook higher education via the race-based quota system. Furthermore, the study advances regarding the existing ones insofar as it also proposes to assess the policy's impact on the completion time and delay.

According to Cameron and Taber (2014), factors associated with the expectation of return to education and individual time allocation preferences can lead students to delay completion. In addition, the socioeconomic conditions in which students find themselves may cause them to need to work, reducing the time that can be devoted to their studies. Thus, since quota students may be embedded in unfavorable socioeconomic contexts, we will also assess the impact of being a quota student on completion time and delay. For this, it is necessary to understand how the processes of admission to higher education via affirmative action occur in Brazil, as presented below.

2.2 Affirmative action and the admission process in Brazilian HEIs

Generally speaking, Brazilian public HEIs have a higher level of social prestige than private institutions, probably resulting from the high competition for admission, whether due to the recognized quality of these institutions or the absence of tuition fees. With the high competition, the seats end up being filled mostly by better prepared students with better schooling conditions. This, in turn, can exclude people in conditions of social and economic vulnerability from these spaces.

In order to change this scenario, the quota policy in Brazil legally came into effect in 2012, when Law No. 12,711 was sanctioned (Brasil, 2012), which was subsequently called the Quotas Law. This regulation aimed to regulate the admission of students from public schools to federal universities

and institutes, also considering criteria such as the level of family income and the students' race. According to this law, federal higher education institutions linked to the Ministry of Education (MEC) should reserve about 50% of their seats for students from public schools (MEC, 2013).

Through the policy, therefore, it would be possible to democratize access to public higher education in Brazil. Populations with under-representation such as public-school students, self-declared black, brown, or indigenous, and people with family incomes of up to 1.5 minimum wages now have specific seat reservations in the different undergraduate programs. Thus, these were the criteria for selecting the public eligible for the quota policy, which could also rely on a combination of these criteria. Students considered eligible to participate in the quota system can also apply for the broad competition if they wish. The quotas are then divided into income and racial-ethnic criteria, and in all modalities it is essential that the students come from public schools.

After taking the National High School Exam (ENEM), students must choose their respective desired centers and programs through the Unified Selection System (Sisu) and indicate whether or not they wish to apply for seats via any of the quota system modalities, in the case of eligible candidates. Some universities also have, in addition to these, their own affirmative action criteria.

The implementation of a quota system in Brazilian universities does not generate costs. This is because there is no expansion of seats, but rather a reservation of the ones already available in each undergraduate program for underprivileged students. What may occur is the generation of some direct and indirect social costs when ineligible students are admitted to universities through quotas. Thus, through the circumvention of rules, students who would have no right (and no need) to quotas may end up taking the seats of those who would actually be the policy's eligible public (Vidigal, 2018).

The policy works to promote the democratization of access to higher education and aims to address the problem of low participation of black, indigenous, and students from public schools in public higher education. Affirmative action for undergraduate admissions in Brazil is already showing its positive effects. Data from the survey "Desigualdades Sociais por Cor ou Raça no Brasil", promoted by IBGE (2019), show that the black population is, for the first time, a majority in Brazilian universities, with a representation of 50.3% of the total. This result may be the consequence of race-based affirmative action policies and may be an indication of their effect on reducing inequalities in Brazilian higher education.

3. Method

To analyze the impact of racial quotas on students' Enade scores and on the delay in completion, it would be ideal to observe the individuals considered treated (policy participants) in the absence of the policy in question. That is, ideally the same individuals should be analyzed with and without the treatment. However, the availability of information does not make this possible.

The potential outcome methodology proposed by Rubin (1974) formalizes the problem.

Being the treatment effect for a student i, with i = 1,...n:

$$\beta_i = Y_i(1) - Y_i(0) \quad (1)$$

where Yi (Si) indicates the potential outcome for performance or delay in completion for each student, S_i equals 1 if the student participates in the policy and 0 otherwise, and β_i the effect of individual treatment. The assessment problem lies in the fact that only one of the potential outcomes is observed. Thus, for the estimation of the treatment effect, the average effect of that treatment on the treated individuals (βATT) must be taken as a reference. Formally:

$$\beta ATT = E[Y_i(1)|\, S = 1] - E[Y_i(0)\,|S = 1] \quad (2)$$

To estimate βATT it is necessary to find a counterfactual group that represents the behavior of treated individuals in the policy's absence, since the counterfactual average for treated individuals is unobserved. So, one solution is to use a method that is able to generate a counterfactual average,

with individuals who have the same observable characteristics as the treated individuals. To this end, two different methods will be used in this paper: propensity score matching and entropy matching. Both methodologies are explained in the next two subsections.

3.1 Propensity score matching (PSM)

The assessment using the propensity score is meant to compare two groups considered statistically identical: the treatment group is delimited as those who participated in the policy, and the control group corresponds to those who, even with statistically identical characteristics, did not participate in the policy in question. This approach was developed by Rosenbaum and Rubin (1983), who sought to measure the difference in averages between a control group and a treatment group through observable characteristics. In the field of policy assessment aimed at higher education in Brazil, it has been used in several studies, including Vidigal (2018) and Becker and Mendonça (2019).

To obtain unbiased estimates, some assumptions must be satisfied in the PSM. The first concerns the Conditional Independence Assumption (CIA), in which unobservable factors do not affect the treatment. Thus, given a set of observable variables X that are not affected by the treatment, the possible outcomes (Y) are independent of the attribution to the treatment. Thus:

$$Y_1, Y_0 \perp S|X \tag{3}$$

It is also necessary to sustain the assumption of a common support between both groups. This assumption allows the treatment group to have corresponding observations in the control group that are close in the propensity score distribution. This can be achieved by discarding cases that are far below or far above the average score. Formally:

$$0 < Pr\ Pr\ (S_i = 1|X_i) < 1 \tag{4}$$

As Rosenbaum and Rubin (1983) explain, PSM calculates the probability of an individual being served by a given policy through a set of observable characteristics and, thus, it is able to combine the information to form a comparison (control) group that is similar to the treatment group. Thus, the PSM behaves as the conditional probability of a given group receiving the treatment given its observable characteristics. Formally:

$$p(X) \equiv Pr\ Pr\ (X) = E\ (X) \tag{5}$$

The individuals' observable characteristics are represented by the vector X. If the propensity score $p(X)$ is known, then the average treatment effect on treated individuals can be estimated as follows:

$$\beta_{ATT} \equiv E\{Y_{1i} - Y_{0i}|\ S_i = 1\} = E[E\{Y_{1i} - Y_{0i}|S_i = 1\}, p(X_i)\}]$$

$$= E[E\{Y_{1i}|S_i = 1, p(X_i)\} - E(Y_{0i}|S_i = 0, p\ (X_i)|\ S_i = 1] \tag{6}$$

The estimates' results for the treatment and control groups are represented by Y_1 and Y_0, respectively. Once the assumptions of balancing the observable variables, conditional independence, and common support are satisfied, the results obtained from the propensity score estimation will be reliable.

Thus, as mentioned, the propensity score is able to estimate the average treatment effect on the treatment group. However, it may happen that the average effect does not fully express the influence of the results' treatment, since these results can be different along the distribution. Thus, to control for this problem, it is possible to make use of the empirical quantile regression strategy, proposed by Koenker and Basset (1978), which can be expressed by:

$$(\beta\tau, \gamma\tau) = \arg min\beta,\gamma \sum W_i \, x \, \rho\tau(Y_i - X_i\gamma - S_i\beta) \quad (7)$$

Where $\rho\tau(u) = u \, x \, \{\tau - 1(u < 0)\}$ and Wi denotes the regression weights. The analytical errors produced by the estimator are consistent even in the presence of heteroscedasticity.

A second issue involving the PSM is that, not seldom, the data show considerable differences, which can compromise the good pairing between the two groups. Thus, it is necessary to use methods that balance the data to reduce these differences. To this end, this study will also use entropy balancing.

3.2 Entropy Balancing

Entropy balancing, developed by Hainmueller (2012), is a multivariate non-parametric method that adjusts sample distributions by reweighting in order to assign weights to the set of observations in the control group to match the units in the treatment group.

This methodology allows all available parallel data to be jointly present when calculating the population weights of non-probability samples, so as to allow the density of X in this sample to be very close to the reference sample (Ribeiro; Costa; Carvalho, 2019).

Thus, considering that the analysis aims at reweighting the control group to match the treatment group's moments, the counterfactual group's average can be estimated by:

$$E[Y^0|S = 0] = \frac{\sum_{(i|S=0)} Y_i w_i}{\sum_{(i|S=0)} w_i} \quad (8)$$

where wi is a weight chosen for each control unit. Entropy balancing estimates the weights through a set of balance constraints seeking knowledge about the sample moments. The weights are chosen by the following reweighting scheme:

$$\min_{w_i} H(w) = \sum_{(i|S=0)} h(w_i) \quad (9)$$

Subject to balance and normalization constraints:

$$\sum_{(i|S=0)} w_i \, C_{ri}(X_i) = m_r \text{ with } r \in 1,...,R \quad (10)$$

$$\sum_{(i|S=0)} w_i = 1 \quad (11)$$

$$w_i \; 0 \text{ for every } i \text{ such that } S = 0 \quad (12)$$

where $q_i = 1/n_0$ is the base weight and $C_{ri}(X_i) = m_r$ corresponds to a set of R balancing constraints imposed on the covariables' moments in the reweighted control group. This methodology, by minimizing equation (6) through weights, allows the groups to be more homogeneous regarding the two observable characteristics. In this way, it is possible to find robust statistics on the impact of the race-based affirmative action policy on the variables of interest.

3.3. Lewbel Method

In an attempt to deal with a possible bias in the βATT estimation caused by unobservable characteristics influencing the treatment, we employed the Lewbel (2012) method. This method assumes that if error correlations are caused by unobserved factors, then the identification of structural parameters can be obtained from uncorrelated regressors with the product of heteroscedastic errors. Thus, the method consists in exploring the errors' heteroscedasticity in the first stage of the regression to internally generate instruments that enable the model's identification. If it is an omitted variable,

which affects the endogenous treatment variable S and indirectly y, it is possible to identify the causal effect of S on y, denoted by γ, through the Generalized Method of Moments (GMM). Formally:

$$Y = X'\beta_1 + \beta S + \varepsilon_1 \quad (13)$$

$$S = X'\beta_2 + \varepsilon_2 \quad (14)$$

$$E[X\varepsilon_1] = 0, E[X\varepsilon_2] = 0, Cov[Z, \varepsilon_1\varepsilon_2] = 0 \quad (15)$$

Where $\varepsilon_1 = a_1U + V_1$ and $\varepsilon_2 = a_2U + V_2$, where V_1 and V_2 are the idiosyncratic errors and Z is a subset of X.

A condition for the method's validity is the presence of heteroscedasticity. We will analyze the assumption's violation through the Breusch-Pagan tests, so that the higher the degree of heteroscedasticity, the higher the correlation of the instruments generated with the endogenous variables. To verify the instruments' validity, we will perform the Hansen's J-test, whose null hypothesis is that the instruments are valid. We will apply the Kleibergen-Paap Wald test to verify the null hypothesis of whether the instruments are weak.

3.4. Data and variables used

To conduct the proposed analysis, we will use the microdata from the Enade in the years 2016, 2017, and 2018. As Enade is applied to different areas within a three-year interval, the temporal choice allows us to obtain results for the three areas analyzed by the exam: Health, Agricultural Sciences, and related areas; Exact Sciences, Teaching Degrees, and related areas; Applied Social Sciences, Human Sciences, and related areas.

The Enade is considered a low risk exam, as students have nothing to lose if they don't achieve a good performance. The biggest consequences are at the institutional level, so that universities can be punished with fewer resources and research grants, for example. Thus, it is not possible to control the effect of the student's seriousness in taking the test. Therefore, it is necessary to highlight a potential bias in the results of academic performance measured as a score in Enade. This, however, does not make our analysis unfeasible.

The individuals considered to be treated will be those who, in addition to meeting the eligibility criteria, were actually admitted to the universities via the race-based quota policy. Students who were admitted to the programs through another modality, even though they met the eligibility criteria, with the same observable characteristics as the treated students, will correspond to the control group. Therefore, we selected the students who took the Enade in the three years analyzed who declared themselves black, brown, or indigenous and who completed high school in a public school. In this selected group, we called "treated" the group of students who were admitted to undergraduate programs through race-based affirmative action, and "control" the group that did not use this admission modality. Although some private universities adopt some social inclusion policies that may contain ethno-racial criteria, the study will define the analysis to public higher education institutions, since these are the ones that must comply with the Quotas Law.

We will analyze the policy's impact on three outcome variables, the students' Enade performance, the time taken to graduate, and the delay in completion. We adopted the delay variable because an analysis of the completion time by students who were admitted through the quotas system would not consider that the programs have different time lengths. In this case, a student who completed an undergraduate program lasting four years but graduated in five, for example, is not in the same situation as another student who graduated with the same length of time but who belonged to a program lasting exactly five years. The delay variable is characterized as the number of years it took the student to complete the undergraduate program beyond the curriculum's minimum time frame. We assigned zero delay to students who completed the undergraduate program on time or even earlier. The variables used are shown in Chart 1.

Chart 1 - Description of the variables used

Variable	Specification
Academic Performance	Dependent Variable, which expresses the students' score in the Enade
Completion time	Dependent Variable, which expresses the length of time the student has been linked to the undergraduate program.
Delay in completion	Variable, which expresses the difference between the it took the student to graduate and the length of the course.
Race-based affirmative action (RAA) quota student	Treatment: Binary variable, worth 1 if admitted via RAA and 0 otherwise (o.w.)
Non-educational variables	
Student's age	Numerical variable, which expresses the students' age (years).
Student's gender	Binary variable, worth 1 if the individual is male and 0 o.w.
Color student	Vector of 3 variables indicating the color/race students (black, brown, indigenous), with the first variable as the reference category
Father's Education	Vector of 3 variables indicating the father's education (father never studied or did not complete Elementary School (PE), father with PE, father with High School, father with Higher Education), with the first variable as the reference category.
Mother's Education	Vector of 3 variables indicating the mother's education (mother never studied or did not complete elementary school (PE), mother with PE, mother with High School, mother with Higher Education), with the first variable as the reference category.
Family member with Higher Education	Binary variable, which is worth 1 if the individual has a family member with higher education and 0 o.w.
Student's Marital Status	Vector of variables indicating the marital status (single,married, or separated/widowed/other individual), with the 'single' variable as the reference category.
Housing Conditions	Vector of 3 dummy variables indicating the housing conditions (individual lives alone, individual lives with parents and/or relatives, individual lives with spouse and/or children, individual lives in a hostel/house/other), with the individual who lives alone variable as the reference category.
Work Situation	Bin. Var. = 1 if the individual works and 0 o.w.
Family income	Vector of 3 variables indicating the family income (FI) of individuals (FI up to 1.5 minimum wages, FI from 1.5 to 4.5 minimum wages, FI from 4.5 to 10 minimum wages, FI more than 10 minimum wages), with the FI up to 1.5 minimum wages variable as the reference category.
Financial Situation	Vector of 3 variables indicating the individual's financial situation (has no income and the expenses are financed by government programs, by the family, or by other people; has income but receives help from the family or other people; has income and does not need help from the family; has income and contributes to the family's support and/or is the main responsible for the family's support),with the first variable as the reference category.
Educational variables	
EJA	Binary variable, which is worth 1 if the individual attended Youth and Adult Education (EJA) and 0 o.w.
Evening course	Binary variable, which is worth 1 if the individual studies at night and 0 o.w.

Variable	Specification
Educational variables	
Knowledge area	Vector that indicates the area of knowledge that the individual belongs to in the undergraduate program (Health, Agricultural Sciences, and related areas; Exact Sciences, Teaching Degrees, and related areas; Applied Social Sciences, Human Sciences, and related areas), with the first variable as the reference category.
Type of HEI	Vector of variables indicating the type of HEI the student studies at (university, university center, college, federal institute of education, science and technology), with the first variable as the reference category.
Access to the Permanence Scholarship Program	Binary variable, which is worth 1 if the individual received some type of permanence grant and 0 o.w.
Scholarship Access	Binary variable, which is worth 1 if the individual received any scholarships and 0 o. w.
Study hours per week	Vector of variables indicating the amount of study hours per week (none, one to three hours, four to seven hours, more than eight hours), with the individual who studies no hours per week variable as the reference category.
Reason for Choosing the Undergraduate Program	Vector of variables indicating the reason for choosing the undergraduate program (labor market insertion, family influence, professional appreciation or social prestige, vocation, and other reasons), with the first variable as the reference category.
Region	Vector indicating the university's location (North, Northeast, Southeast, South, and Midwest), where the Southeast region variable is the reference category.

Source: INEP (Enade and Higher Education Census).

The performance on Enade is represented by the student's score in absolute terms. Since students' performance can vary according to their respective programs, one solution to control this effect was to normalize, or standardize, the score.

In addition to the treatment and outcome variables, Table 1 also presents the description of the variables used to pair the control and treatment groups, which also function as controls in the ATT estimates. Among the non-educational variables, we selected those that represent both the individuals' characteristics (such as gender and age) and the conditions to which they are subjected (such as marital status, the region where they study, housing conditions, and their work and financial situation).

The variables age and man refer to the characteristics of individuals and, according to Desjardins et al. (2002), older students have higher opportunity costs, which can increase the completion time. In addition, older individuals, because they often need to divide their time allocation between work and study, may have their academic performance compromised.

Parental education can be associated with both student performance and the time taken to graduate. The literature has already investigated that parents' level of education has effects on their children's school feedback (Reis & Ramos, 2011; Vernier, Bagolin & Fochezatto, 2017).

Family obligations that generally fall on older, married individuals or those living with spouses and children can increase these students' opportunity cost (Rocha, 2016). The fact that the student works can cause negative effects on performance throughout the undergraduate program due to time allocation.

Family income, financial situation, housing condition, and the provision of grants to keep students in their programs can be related to the permanence of students in their respective programs, as well as to their performance and completion time. Still, both family income and financial situation help explain the demand for education and may influence whether or not the student chooses

admission via quotas. According to Kane (2003), there is a strong positive correlation between family income and undergraduate enrollment, permanence, and completion rates.

Students who study at night, have completed their studies in public schools, or have taken some special education modality such as supplementary education or Youth and Adult Education (EJA), may have their performance and completion time impaired (Oliveira et al., 2013). This is due to both time allocation, since students who study at night often work during the day, and school background, in the other two cases.

Academic performance and completion rates can differ between different knowledge areas and between different types of institutions. Cunha (2006) and Pinheiro (2014) observed differences in the performance of quota and non-quota students in the Exact Sciences area. Access to some kind of scholarship or undergraduate program grant can also influence students' completion rates.

Students who devote part of their weekly time to study possibly have better scores. Students who opt for social inclusion modalities for admission into higher education may have better freedom of undergraduate program choice, choosing those that would get them faster into the labor market. Fraga et al. (2019), observed that students who were admitted to higher education through the University for All Program (Prouni) or were beneficiaries of the Higher Education Student Financing Fund (FIES) had less freedom of undergraduate program choice than those who were admitted into higher education through another modality. Students from Prouni and FIES had even lower chances of being in the undergraduate program they had always dreamed of when compared to non-beneficiaries.

Finally, we also used a categorical variable as a control to differentiate the country's regions. The results we obtained from the analysis are presented below.

4. Results

This section we will present the results of the methods used in the study. The first subsection contains the estimations of the model that estimates the probability that the student is a quota student. In the second subsection, we present the results of the impact assessment of racial quotas on performance, time, and delay in completing higher education.

4.1. Probability of participation in the race-based affirmative action policy

Table 1 shows the results of the probit model, which estimates the probability of participation in the race-based quota policy. That is, given the observed characteristics, the model estimates the probability that the student is a quota student.

Table 1- Probit model for the probability of receiving treatment

	Coef.	**Robust standard error**	**Marginal Effect**	**Robust standard error**
Non-educational variables				
Age	0,006***	0,001	0,000	0,000
Man	0,084***	0,014	0,011	0,001
Color 0 (black)				
Color 1 (brown)	-0,885***	0,013	-0,164	-0,164
Color 2 (indigenous)	0,108**	0,052	0,032	0,003
FatEd 0 (N. PE)				
FatEd 1 (PE)	0,035*	0,020	0,005	0,002
FatEd 2 (HS)	0,032*	0,018	0,004	0,002
FatEd 3 (HE)	0,048*	0,028	0,006	0,004
MotEd 0 (N. PE)				
MotEd 1 (PE)	-0,040*	0,020	-0,005	0,002
MotEd 2 (HS)	-0,026	0,018	-0,003	0,002
MotEd 3 (HE)	-0,035	0,025	-0,004	0,003
FamilyMemberHE	-0,021	0,015	-0,003	0,002
Marit.Stat 0 (single)				
Marit.Stat 1 (married)	0,001	0,027	0,000	0,003
Marit.Stat 2 (separated)	-0,012	0,031	-0,001	0,004

	Coef.	Robust standard error	Marginal Effect	Robust standard error
Non-educational variables				
HousCond. 0 (alone)				
HousCond. 1 (parents)	-0,046*	0,027	-0,006	0,004
HousCond. 2 (spouse)	-0,080**	0,034	-0,011	0,004
HousCond. 3 (hostel)	0,061	0,032	-0,008	0,004
Works	0,016	0,020	0,002	0,002
FI 0 (up to 1.5)				
FI 1 (from 1.5 to 4.5)	0,002	0,016	0,000	0,002
FI 2 (from 4.5 to 10)	-0,007	0,026	-0,001	0,003
FI 3 (+ 10)	0,061	0,055	0,008	0,008
Fin. Sit. 0 (no income)				
Fin. Sit. 1 (help)	-0,040*	0,021	-0,005	0,003
Fin. Sit. 2 (no help)	-0,090***	0,032	-0,012	0,004
Fin. Sit. 3 (contributes)	-0,116***	0,024	-0,015	0,003
Educational variables				
Grant	0,112***	0,016	0,015	0,002
Scholarship	0,035**	0,015	0,005	0,002
EJA	0,081**	0,036	0,011	0,005
Study Hrs 0 (none)				0,005
Study Hrs 1 (from 1 to 3)	0,146***	0,047	0,017	0,005
Study Hrs 2 (from 2 to 7)	0,168***	0,047	0,020	0,005
Study Hrs 3 (+ 7)	0,180***	0,048	0,022	0,005
Choos.Prog. 0 (labor market)				
Choos.Prog. 1 (family)	-0,002	0,032	0,000	0,004
Choos.Prog. 2 (prestige)	-0,007	0,024	-0,001	0,003
Choos.Prog. 3 (vocation)	-0,038**	0,018	-0,005	0,002
Choos.Prog. 4 (other)	-0,578***	0,019	-0,008	0,002
Night	0,070***	0,015	0,009	0,002
Type Inst. 0 (University)				
Type Inst. 1 (Centers)	-0,614***	0,109	-0,055	0,005
Type Inst. 2 (College)	-0,504***	0,048	-0,049	0,003
Type Inst. 3 (Institutes)	-0,030	0,025	-0,004	0,003
Knowledge Area 0 (Health)				
Knowledge Area 1 (Exact Sciences)	-0,034	0,057	-0,004	0,007
Knowledge Area 2 (H. Sciences)	0,124**	0,063	0,018	0,008
Region 0 (Southeast)				
Region 1 (North)	-0,259***	0,025	-0,027	0,002
Region 2 (Northeast)	0,101***	0,018	0,014	0,002
Region 3 (South)	0,281***	0,028	0,044	0,005
Region 4 (Midwest)	0,197***	0,024	0,029	0,003
2017	0,035	0,544	0,004	0,007
2018	0,034	0,609	0,004	0,008
Const.	-1,170***	0,072		
Observations	74.766			
Log pseudolikelihood	-20513,63			
Pseudo R^2	0,1187			

Source: own preparation based on the study's results.
Note: ***, **, and * are the significances at the 1%, 5%, and 10% level, respectively.

The estimated coefficient for student age was positive and significant at 1%, but the marginal effects were close to zero. Men are more likely to participate in the policy, while individuals self-declared as brown are less likely to enter via racial quotas compared to individuals self-declared as black. Being indigenous increases the probability of being a quota student if compared to black individuals.

Individuals with parents who have completed elementary school, high school, or higher education are more likely to receive treatment compared to students with parents who have never studied or have not completed elementary school. The mother's education coefficient was significant only for people with mothers with complete elementary school education, and this decreases the probability of being a quota student. Having some other family member with a complete higher education, on the other hand, did not show statistical significance in the individual's probability of participating in the policy.

According to the literature, the schooling of fathers, especially that of mothers, is closely related to the schooling of their children and even to their insertion in the labor market (Cadaval & Monteiro, 2011; Reis & Ramos, 2011; Vernier; Bagolin & Fochezatto, 2017). Thus, a higher probability of students with more educated parents participating in the race-based quota policy may be associated with the fact that the student is seeking access to higher levels of study, influenced by their parents. On the other hand, a lower probability of students with educated parents participating in the policy, as in the case of the coefficient for mothers with elementary school education, may be associated with a higher score in the ENEM on the part of the student, thanks to the school background, which gives him/her more freedom to choose other admission modalities.

Students who live with their parents or with their spouse have, respectively, a reduced probability of participation in the race-based affirmative action policy by -0.006 and -0.011 compared to students who live alone. With regard to financial situation, in general, students with some income are less likely to be admitted into undergraduate programs via racial quotas. Individuals who have income but still need family help have a lower probability at -0.005, students who have income and do not need family help have a reduced probability of participating in the policy at -0.012. On the other hand, students who, in addition to having an income, also contribute to the family support, have -0.015 lower probability of participation.

Receiving a scholarship or grant increases the probability of being a quota student, as does studying at night or having completed high school through the EJA modality. According to Oliveira et al (2013), students who study at night generally have lower performance. These students sometimes divide their time allocation between work and studies, which can compromise performance.

Students who devote part of their weekly time to study are more likely to participate in the policy. Students who study about one to three hours per week have about 0.017 higher probability of participation, while those who study four to seven hours per week and more than eight hours have, respectively, 0.020 and 0.022 higher probability compared to those who study no hours per week.

Students who choose their respective undergraduate programs because of vocation, low competition for admission, or for another reason, are less likely to participate in the policy of race-based affirmative action for higher education compared to those who choose their programs for their greater insertion in the labor market. These results may indicate that students who are admitted via this modality have less freedom in choosing programs, being concerned with market insertion and a quick financial return.

It was also possible to observe that students from university centers and colleges are less likely to participate in quotas compared to students from universities. Students in Applied Social Sciences, Human Sciences, and related areas are more likely to participate in racial quotas than students enrolled in Health Sciences, Agricultural Sciences, and related areas. With the North region's exception, students from all other regions have a greater chance of choosing to be admitted via the quota system than students from the Southeast region.

After the probit model's results, it was possible to apply the propensity score matching methodology. In this step, we used pairings by 1 nearest neighbor - Nn(1), 3 nearest neighbors - Nn(3), 5 nearest neighbors - Nn(5), and Kernel. We assessed the balancing's quality using the tests proposed by Dehejia and Wahba (2002). There were no observations outside the common support. The tests' results are shown in Table 2.

Table 2 - Balancing Quality Tests

Sample	Pseudo-R^2	LR χ^2	$p > \chi 2$	Mean bias	Median bias
Not paired	0,119	5526,83	0,000	7,6	4,3
Nn(1)	0,002	31,35	0,939	1,0	0,9
Nn(3)	0,001	14,77	1,000	0,7	0,5
Nn(5)	0,001	12,36	1,000	0,6	0,4
Kernel	0,011	213,82	0,000	2,8	1,7

Source: own preparation based on the study's results.

The results show that the pairing reduced the Pseudo-R^2 to values close to zero, which is evidence of good pairing quality. The Likelihood Ratio (LR) test's results indicate that the regressors were jointly non-significant when using the nearest neighbor algorithm, which supports the evidence of a quality pairing.

The bias after pairing, given by the difference in mean and median between the observable characteristics of the treatment and control groups, was reduced. The best results of Dehejia and Wahba's (2002) test were found using pairing by the 5 nearest neighbors. The estimation of the average treatment effect (ATT) on student performance is presented in the following subsection.

4.2 The impact of race-based affirmative action policy on performance, time, and delay in completion.

The results of the average treatment effect (ATT) on students' Enade scores, time, and delay in completion are presented in Table 3. In addition to the results, we obtained using the propensity score method (PSM) with the 1, 3, 5 nearest neighbor and Kernel algorithms, the estimates using the entropy matching method are also presented. In an attempt to deal with the possible bias of unobservable characteristics that may influence the individual student's decision to be admitted via the quota modality, we present the results estimated by the Lewbel (2012) method. We confirmed the presence of heteroscedasticity, a necessary condition to confirm the method's validity, using the Breusch-Pagan test ($x2$ = 21289.68). The results of Hansen's J-test, present in the last rows of the following table, allowed the failure to reject the null hypothesis at 5% for the variable referring to performance (score), which is evidence of the instruments' validity. However, for the variables time and delay in completion the null hypothesis is rejected. We also estimate the results using ordinary least squares (OLS) for comparison.

Table 3 - Average Treatment Effect (ATT) Estimates

ATT	*Score*	*Delay*	*Completion time*
OLS			
	-0,032***	-0,018	-0,016
	(0,011)	(0,017)	(0.020)
PSM			
Nn(1)	-0,041**	-0,036	0,152
	(0,018)	(0,011)	(0,028)
Nn(3)	-0,039***	-0,013	0,041
	(0,014)	(0,021)	(0,023)
Nn(5)	-0,034**	-0,004	-0,006
	(0,014)	(0,019)	(0,022)
Kernel	-0,028**	-0,006	0,000
	(0,012)	(0,017)	(0,020)
Entropy			
	0,431	-1,061	-1,334**
	(0,451)	(0,800)	(0,678)
Lewbel			

ATT	*Score*	*Delay*	*Completion time*
Lewbel			
	-0,741***	0,063**	0,075**
	(0,020)	(0,030)	(0,033)
Hansen J ($\chi 2$)	57,438	137,920	148,681
p-value	0,0842	0,000	0,000

Source: own preparation based on the study's results.

The results indicate that admission to higher education via affirmative action policy impacts on a decrease, though small, of the students' performance on the Enade. The impact estimated by the PSM, using the 5 nearest neighbors, was around -0,034 on the students' Enade score. We used OLS and the propensity score and found no statistically significant impacts on the completion time and nor on the delay. The estimation from entropy matching indicated a decrease of about 1 year and 3 months in the time the student stays linked to the undergraduate program. However, the most suitable results are those estimated by the PSM using the 5 nearest neighbors, as demonstrated by the test results.

The Lewbel (2012) method's estimation results, in turn, highlighted a possible underestimation of the average treatment effect when unobserved student characteristics are not considered. The result on Enade performance through this method was about -0,741, which is higher than the other analyzed estimates. In addition, we found an result of about 0,063 years on the delay in completion and an result of 0,075 on the time it takes the student to complete the undergraduate program.

We also used the quantile treatment for the Enade score in an attempt to verify whether the results are very different along the distribution, which would imply an incomplete representation of the average effect on the treatment's influence. However, the results pointed to a non-statistically significant effect at all quantiles. These results are found in Appendix A.

The results indicated, in general, that the race-based affirmative action policy for higher education minimally reduces the students' performance in the Enade, but on average it has no impact on the time the student takes to graduate, or on a possible delay in graduating. The difference in performance we found was very small, and it is possibly linked to issues such as these students' socioeconomic conditions and school background, which are variables not included in the model. Estimates by the Lewbel (2012) method point to the influences of unobservable characteristics on the average treatment effect. After all, as Wainer and Melguizo (2018) explain, students who are admitted to higher education through affirmative action generally have greater deficiencies in acquired human capital, due to the socioeconomic and racial inequalities that exist in Brazil.

5 Conclusion

This study assessed the race-based quota policy's impact on performance, total time, and delay in completion of students from Brazilian public HEIs who took the Enade in 2016, 2017, and 2018.

The results showed a small reduction in the Enade score of students who were admitted to the undergraduate program via the race-based quota system. However, we found no significant effects on the length of time the student remained linked to the HEI of origin. Among the reasons that lead students to opt for admission to the undergraduate program via affirmative action, we found that issues such as color, financial situation, and the amount of time dedicated to studies, among others, have significant effects on individual decision making.

We observed that brown students are less likely to opt for admission via race-based affirmative action compared to black students, but indigenous students tend to opt for this modality, which may indicate the existing social disparities even within the group of eligible publics for the policy. In addition, students who have some income are less likely to opt for this type of admission compared to those who have no income at all, which highlights the policy's inclusive nature. The study also allowed an approach to an important point: students who dedicate more time to their studies on a weekly basis are more likely to be admitted via affirmative action compared to those who do not

dedicate hours to their studies. This may be an indication that the existence of a seat reservation policy does not cause students to put less effort into admission and permanence in undergraduate education. At the same time, it can be an indication that the fact that the student has been admitted through a reserved seat, generally less competitive, means that he/she has to make more effort to follow the undergraduate program's courses if his/her previous knowledge is inferior to the others.

In view of what we observed, it is possible to see that the benefits that can be obtained with affirmative action are greater than any eventual problems, such as a small impact on performance. This undesired result may indicate the need for more attention directed to the students who are admitted into the undergraduate program via this modality, by providing leveling to monitor the program and seeking to create mechanisms for these students' permanence. The literature indicates the importance of such policies for the access of minority groups to higher education, revealing the notoriety of the existence of social inclusion policies for a greater democratization of the higher levels of education.

Among the limitations encountered in the study's development, we highlight the factors that cannot be controlled which may be associated with the probability of the student opting for admission to the undergraduate program via race-based affirmative action. The results we obtained using the Lewbel method pointed to a possible underestimation of the results when unobserved student characteristics are not considered. We suggest that future work could analyze the policy's impact on the demographic composition of Brazilian HEIs, seeking to verify the importance of race-based affirmative action in increasing diversity in the Brazilian higher education.

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Appendix A - Results of the Quantile Treatment Effect

Quantile	**Coefficient**	**Standard error**	**p-value**
Quantile 0,1	0,021	0,027	0,445
Quantile 0,2	0,035	0,022	0,141
Quantile 0,3	0,035	0,022	0,120
Quantile 0,4	-0,007	0,023	0,768
Quantile 0,5	0,007	0,023	0,767
Quantile 0,6	-0,007	0,023	0,760
Quantile 0,7	-0,028	0,023	0,222
Quantile 0,8	-0,014	0,025	0,579
Quantile 0,9	-0,014	0,030	0,643

Source: Self elaboration.