Affirmative action and demand for schooling: evidence from nationwide policies

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Abstract

Affirmative action policies in higher education have been adopted in different settings to reduce structural inequality in college enrollment and attainment. There is increasing evidence on the efficacy of these policies to increase the representation of underrepresented groups in higher education. Less is known, however, about their impact on students' choices and outcomes before college. This paper studies how affirmative action affects high school persistence and demand for college. Our paper leverages cross-sectional and time variation in exposure to changes in local and nationwide affirmative action policies adopted in Brazil. These policies primarily targeted applicants from public high schools to indirectly reduce socioeconomic and racial inequality in college access. Aligned with theoretical predictions, our results show that affirmative action increases high-school persistence and demand for college for public-school students, the targeted group. In contrast, it negatively affects persistence and demand for public colleges among private-school students, the non-targeted group. Given the income sorting between public and private high schools in Brazil, these results show that affirmative action shrinks the socioeconomic gap in school persistence and demand for public colleges.

JEL Codes: D10, H31, I24, I25, I28.
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1 Introduction

Affirmative action in higher education is a popular yet controversial policy used to increase college attainment of historically underrepresented groups. An empirical literature has studied the race-based affirmative action bans in the US in the mid-1990s[1], quotas targeting low castes in India, and income and race-based quotas in Brazil.[2] This literature provides evidence on the efficacy of affirmative action in increasing college enrollment among historically underrepresented groups in higher education.

In parallel, a more recent empirical literature has focused on uncovering the indirect effects of affirmative action on pre-college outcomes (e.g. Card and Krueger, 2005; Antonovics and Backes, 2014; Akhtari et al., 2020). These papers build on the theoretically supported hypothesis that changes in the likelihood of college acceptance induced by preferential admissions affect the behavior of targeted and non-targeted groups differently (Bodoh-Creed and Hickman, 2018). These behavioral predictions support the importance of further understanding how affirmative action in higher education affects students' decisions and choices at earlier stages of their education trajectories. Yet, the empirical evidence in the area is scarce.

Our paper focuses on the dynamic effects of affirmative action in college admissions: does affirmative action affect demand for schooling among high-school students? Mainly, we investigate whether affirmative action policies enacted in Brazil over several years affect high school persistence, graduation, and demand for college. Our analysis focuses on how affirmative action affects (i) the proportion of high school students dropping out, (ii) graduating, and (ii) taking up the National High School Exam (ENEM - Exame Nacional do Ensino Médio), a centralized federally-managed exam applied nationwide once a year and used for college admissions.

[1] See Arcidiacono et al. (2015) for a review

[2] For India, see Bertrand et al. (2010); Bagde et al. (2016). For Brazil, Francis and Tannuri-Pianto (2012); Mello (2021); Vieira and Arends-Kuenning (2019)

The Brazilian context is especially relevant to investigate affirmative action (AA) and demand for schooling. First, AA in Brazil was adopted by over a hundred institutions nationwide, which vary in capacity and quality. Second, almost all universities adopted a quota-type policy targeting public high school students to address socioeconomic inequalities, providing clear criteria for identifying the beneficiaries. Third, admission to all universities is exclusively based on entrance exam scores. These facts build a clear context for the study of affirmative action policies in higher education, one that differs from cases in the US, where universities adopt a holistic approach to admissions, indirectly practicing preferential admissions even in the absence of well-defined policies.[3]

We explore two levels of variation in treatment intensity. First, temporal and geographic differences in the share of the seats locally assigned to affirmative action provide a treatment measure with extensive variation at the municipality-year level. Second, a federal policy provides additional and substantial variation in treatment intensity. After a decade of universities progressively adopting affirmative action policies, in 2012, the federal government passed a national affirmative action law. The new mandate consisted of all federal higher education institutions reserving at least fifty percent of the vacancies in each major for students who attended upper secondary education in a public school, with income and race sub-criteria included. This law substantially increased the proportion of seats allocated to affirmative action during our study period.

Our empirical analysis also leverages the differential changes in the probability of college acceptance for students across public and private high schools. Socioeconomic sorting across high schools in Brazil happens mainly at the high school administration level, public or private. Consequently, most affirmative action policies in Brazil target public high school students. For the cases in which only income or race components are required, public school students are still indirectly more affected by the policy than their private high school coun-

[3]See Bleemer (2019) and Arcidiacono et al. (2022) for ways US universities practice preferential admissions even in the absence of affirmative action policies.

terparts. An increase in reserved college seats relatively increases public school students' college acceptance chances. On the other hand, such affirmative action policies lower college acceptance chances for private high school students.

We combine publicly available administrative data from several sources from 2010 to 2014. We aggregate individual-level data at the school level to create the outcomes of interest: high school dropout, graduation, and demand for college. We combine this data with a rich set of information on college admissions, including the number of new seats offered yearly, the type of admissions, and the proportion of seats reserved for affirmative action. The resulting data is a panel at the school level, covering 16,043 high schools across 3,689 municipalities and 315 microregions.

Our results show that affirmative action decreases high school dropout rates and increases demand for college for students of historically underrepresented groups in higher education. However, we also find negative effects for students from private high schools, a group for which public college acceptance rates decrease substantially. Specifically, we find that the full adoption of AA reduces the share of public school students dropping out by 8.9 percent, increases graduation rates by 2.3 percent, and the demand for college by 10 percent. On the other hand, we see a negative effect on persistence for private school students, which is a group that does not benefit from the policies. For this group, dropout rates increase by 10 percent; there are no effects on graduation rates and demand for college decreases by 7.7 percent.

Heterogeneity by socioeconomic status (SES) complements these main findings with important insights. The most striking difference emerges for the outcome of demand for college, with the increase in demand among public high school students driven by low-SES students - for whom the chances of acceptance increased relatively more. At the same time, the decrease in demand for college among private school students is driven by high-SES students, a group with a more extensive set of outside options.

Our paper provides empirical evidence to recent theoretical predictions. For instance, Bodoh-Creed and Hickman (2018) (BH) models the competition between high school seniors for seats in college. In an applied exercise motivated by BH model, Cotton et al. (2022) provides experimental evidence showing that the introduction of affirmative action increased investments among the disadvantaged group, leading to higher exam scores when compared to the baseline of no preferential admissions.

Our study also directly relates to recent and growing literature on the effects of affirmative action on pre-college outcomes. Earlier papers explore the ban of affirmative action in California in the mid-1990s and its impact on minorities' pre-college outcomes (Card and Krueger, 2005; Antonovics and Backes, 2014). More recently, Akhtari et al. (2020) shows that the reinstatement of race-based AA in Texas increases the pre-college human capital investment of the benefited groups, demonstrated by an increase in SAT scores, grades, and attendance.

Previous studies from Brazil provide suggestive evidence on pre-college behavior, restricted to pre-college preparation effort. Francis and Tannuri-Pianto (2012) evaluate one of the first Brazilian race-based affirmative action experiences at the University of Brasilia (UnB). Although not the main focus of their paper, they find no evidence of an effect on students' pre-university efforts. Similarly, Estevan et al. (2018) evaluate the bonus-type affirmative action implemented by Unicamp and also find no effect on pre-college effort. These studies are restricted to students directly applying to highly competitive colleges, which may limit the scope for behavioral responses.

The richness of the Brazilian data on the universe of high schools in Brazil improves over contexts evaluating local policies or those restricted to relatively high achieving college applicants. Additionally, we explore unique variation in policy intensity, and we are the first to explore short-term effects induced by local and nationwide policies. Moreover, the policies we evaluate explicitly target public high schools, allowing us to examine heterogeneous effects by

high school type and quality. In our context, universities are passive agents in the admission process in our setting, conditional on the pre-determined rules. Quotas applied in an exam-only admissions criterion, as in the Brazilian case, give explicit information to students, allowing a more precise interpretation of our results.

This paper proceeds as follows. In section 2, we describe the education system and higher education policies in Brazil. In section 3, we describe the data and provide summary statistics. In section 4, we outline the identification strategy and in section 5 we show and discuss the results for the effects of affirmative action on schooling. Section 6 concludes.

2 Education in Brazil

2.1 From high school to college

Education in Brazil is a mix of private and public institutions. At the high school level, most institutions are public, accounting for 87 percent of enrollment. There are no direct fees to attend a public high school[4], and they are administered mostly at the federal and state levels. Private high schools charge tuition, with considerable variability in costs and quality.

High school education takes three years. While school enrollment among children aged 6 to 14 is virtually universal, the same was not achieved among high-school-aged teenagers. However, there was remarkable progress in two decades. From 2000 to 2015, high school enrollment for individuals aged 15 to 17 increased from 34.4 to 56.9 percent.[5] Still, education attainment and persistence among the youth remains a challenge in Brazil.

In contrast, private institutions (profit or non-profit) account for 74 percent of enrollment in higher education, while their quality and tuition fees vary widely. Public institutions,

[4]Schools are funded by a mix of federal and state transfers. Resources are first centralized and then redistributed across states and schools. Roughly speaking, resources are allocated nationwide and proportional to school size. As a result, the relationship between school quality and financial resources is much less geographically dependent than in the U.S.

[5]Source: IBGE - Pnad (Pesquisa Nacional por Amostra de DomicÌlios).

instead, are tuition-free and perceived as higher quality than their private counterparts. Admissions are highly competitive, and generally, public institutions are the preferred option for students applying for college. Our study focuses on affirmative action policies adopted by public universities.

Applications to higher education are at the college-major level. Admissions to all public universities are based on exam scores only. For decades, college admissions in Brazil were decentralized. Universities each had their own process, and applicants directly chose to apply to one or more institutions. At each institution, applicants could choose only one major. Admissions were based on a combination of university exams (*Vestibulares*) and the ENEM, a centralized, federally-administered high school exam mainly used for college admissions. For the 2010 admissions round, the federal government created a centralized college admissions system (SISU). Adherence to SISU was voluntary and available to all public institutions of higher education in the country. For universities adopting SISU, admissions were solely or largely based on ENEM. Within this new system, applicants can choose up to two majors, each major either at the same or at two different institutions.

ENEM is a non-mandatory national exam initially created as a high school evaluation and mostly taken by people interested in college. The exam takes place before college applications. The test works as a self-assessment tool, and students' scores reveal their chances to get into college and specific majors. Students can use their scores to apply to public universities and get federal financial aid to access private institutions (scholarships or student credit). The exam is administered once a year, with exam locations spread across the country. Anyone can take the exam, from high school seniors to adults of any age aiming to pursue tertiary education.

Even though students can apply to their preferred major anywhere in Brazil, interstate migration for college purposes is small. About 10 percent of students enrolled in college come from a state different than their home states (Machado and Szerman, 2021). The reasons for

this low cross-state migration for college reasons are unclear. Still, a few options include the high costs involved, the non-existence of educational credit covering living expenses, the low supply of college dorms, and cultural aspects. These mobility constraints are central to our identification strategy.

2.2 Affirmation action in higher education

As a result of intense debate during the 1990s, the first universities started to adopt affirmative action policies in Brazil in the early 2000s. In 2003, the State of Rio de Janeiro adopted the first extensive affirmative action policy, reserving half of its seats to students from local public schools and black students. In 2004, the University of Brasilia reserved 20 percent of its total seats for black applicants. These two pioneer experiences set in motion the adoption of affirmative action by Brazilian universities.

In 2012, the federal government announced a new large-scale admissions policy that mandated all federal higher education institutions to follow a set of minimum requirements for quotas in admissions. The federal law 12.711/2012, also known as "*Lei de Cotas*", mandated all federal institutions, starting in 2013, should allocate a minimum of 12.5 percent of their total seats to students from public high schools.[6] Universities should each year increase the minimum of reserved seats. In 2014, they should allocate 25 percent, in 2015 37.5 percent, until they reach 50 percent of the total seats in 2016. Universities were free to reserve more than the minimum requirement. The federal policy combines both color-sighted and color-blinded components.[7]

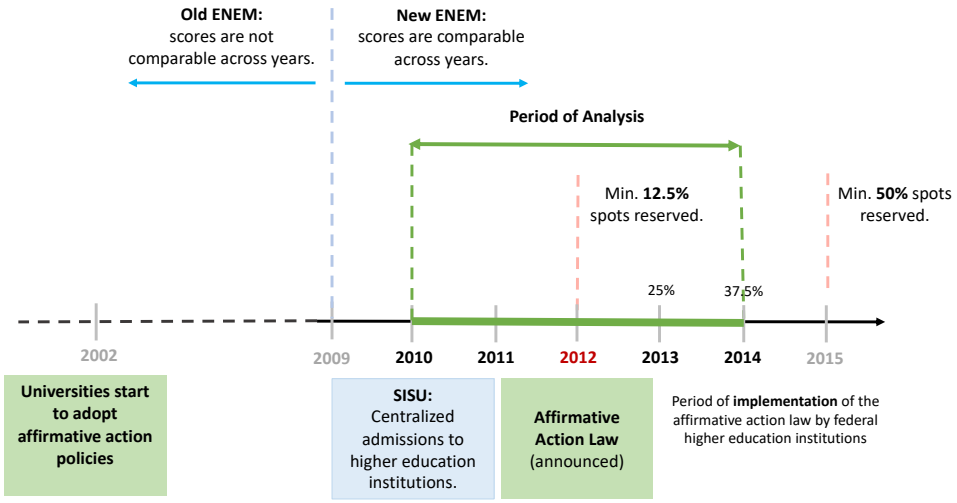
[6] They require that students must have studied all three years of high school in public institutions. This avoids the possibility of, for example, transferring from a private to public high school in the last year to benefit from the policy. Students can still migrate from a private middle school to a public high school, benefitting from the policy three years later.

[7] In total, there are four "quota" groups, for which the minimum common condition is a public high school diploma. Within the public high school group, 50 percent had to comply with a maximum income requirement of 1.5 times the minimum wage per household member. The other 50 percent had no income restrictions. Within each income group, a minimum percent goes to applicants who self-declared belonging to an ethnic minority group (black, *pardos* and indigenous). This percentage varies geographically, and it is equivalent to the share of minorities in the state where the university is located, according to the most recent population census. Figure A.1 summarizes the law's requirements.

By 2014, 136 higher education institutions in Brazil adopted some affirmative action policy. There was extensive variation in the type of affirmative action adopted. Most higher education institutions adopted quotas targeting public school students, many of which combined this with additional race and income-based criteria.

Our study restricts analysis to universities and colleges, excluding the federal institutes for higher education. These federal institutes are under the federal government's administration and were also mandated to adopt affirmative action. However, these institutions offer multiple education levels: high school, two-year technical courses, and four-year college. We decide to include these institutions only as high school institutions. Without accounting for federal institutes as higher education, the number of colleges and universities adopting affirmative action increases from 58 in 2010 to 94 in 2014.

Figure 1: Summary of relevant events



Note: This figure summarizes the events during the period of analysis (2010-2014). ENEM is the national high-school exam, used as the main outcome variable. The affirmative action law enacted in August 2012 was gradually implemented from 2013 to 2016 nationwide for all federal higher education institutions. SISU refers to the centralized admissions system.

Figure 1 summarizes the main events within the period of analysis in this study. The

figure also includes the 2010 creation of the centralized college admissions system (SISU). SISU was enabled nationwide, with adoption varying over time and geographically. For instance, since colleges adopting SISU use ENEM as mandatory a admissions criterion, joining the centralized system can directly affect exam registration without necessarily affecting demand for higher education. In our primary analysis, we control for the number of seats offered through SISU.

3 Data description

We use five public datasets (i) Census of Basic Education; (ii) a national high school exam data - ENEM; (iii) Census of Higher Education; (iv) centralized admissions system (SISU) data; (v) university affirmative action adoption data. Datasets (i)-(iv) are administered by the Brazilian Ministry of Education, and dataset (v) was collected by one of the authors (Mello, 2021).

3.1 Data on high school persistence and graduation

The Census of Basic Education (CBE) is an administrative database with detailed information at the student, classroom, teacher, principal, and school level. Using individual-level data from 2010 to 2014, we construct yearly information on high school students per school. Using the individual-level panel, we follow high school students to construct the school-level variables on the share of students progressing, repeating, and dropping out of school in the first and second years of high school. For high school seniors, we also observe their graduation status.

We impose some restrictions on the set of schools on which we focus our analysis. We restrict it to schools offering all three years of high school ($\approx$ 78 percent). We drop schools that opened or closed during our period of study, keeping schools we observed in all years ($\approx$ 80 percent). Finally, we limit our analysis to typical high schools ($\approx$ 94 percent). We

exclude special high schools (education for students with special needs or adult education) and high schools with non-regular grades and instructional hours.

3.2 Data on demand for college

The ENEM database provides our primary information on college demand. It covers the population of test-takers in Brazil. We use data from 2010 to 2014, covering on average 6.5 million people per year. It contains information collected at the time of application (May/June), complemented with their subsequent exam performance (October/November). Although anyone interested in pursuing higher education can take this exam, we focus on the population of high-school seniors, comprising around 20 percent of all the exam takers. We use the information on the high school attended, municipality, and state of residence, in addition to their exam status (present or not). We aggregate this data at the school-year level and calculate the number of high-school seniors present on exam day. We merge the CBE with the ENEM database at the school level to construct our demand for college variable: the share of high school seniors per high school present on exam day.

Our analysis database is a school-level panel from 2010 to 2014. We correct for some inconsistencies in the data, corresponding to 4.3 percent of observations. Each year, 3-5 percent of schools have more students registered in the exam than enrolled in the school. These inconsistencies can be due to measurement error and student movement between the Census reference date and ENEM registration dates. We correct for these inconsistent ratios in two ways. If the ratio is less than 1.05, we set the ratio to be equal to 1. If the ratio is more than 1.05, we replace it with the average of the other years.

3.3 Data on affirmative action and the centralized admissions system adoption

Our treatment variables are calculated using the Census of Higher Education (CHE), merged with information on the adoption of affirmative action and centralized admissions.

The CHE is an administrative database covering all universities, majors, and college students in the country. From this database, we use information from 2011 to 2015 on total enrollment and total new seats offered at the university-campus. Note that for treatment data, our reference years in the administrative datasets are always the year following the ENEM and Census. This is because the school academic year in Brazil is from February to December. Therefore, high-school seniors in any given year are treated with information that shows up in the higher education data in the following year. By the time they take the ENEM exam, they know about the number of seats and policies next year. Our treatment is the information about the policy.

We aggregate the university data at the municipality-microregion level. Microregions are geographic units larger than a municipality and smaller than a state. According to the Brazilian Institute of Geography and Statistics (IBGE), a microregion is defined based on economic integration. The choice to aggregate up to the microregion level allows neighboring municipalities, often connected by public transportation, to be treated with the same intensity. The resulting microregion-year level data contains the total number of college seats available each year - this variable pools information for cases when microregions have more than one university or campus.

We merge information from the CHE with data on affirmative action (AA) adoption across all universities in the country. This dataset includes information on both federal and state institutions. From 2011 to 2015, it contains manually collected data on the total number of vacancies allocated to AA at the university-major-level per year. This data was originally used in Mello (2021). We aggregate this variable at the microregion level to construct the number of reserved college seats in each microregion with one or more universities. We keep microregions that were ever treated from 2011-2015. We merge this data with the microregion-level data created from the CHE, in which we have the total number of college seats per municipality. We then create the affirmative action treatment variable as the proportion of college seats reserved for AA.

Finally, we also use the centralized admissions system (SISU) implementation data. It contains detailed information on the number of seats offered through the SISU system at the year-university-campus-major level. We aggregate this data at the microregion level, creating a variable containing the total number of college vacancies offered through SISU. We merge this information with the total number of college seats at a microregion obtained from the CHE. We create the SISU adoption variable as the proportion of college seats offered through SISU relative to all college seats offered at a microregion. This data also contains the number of seats provided through SISU that were reserved for affirmative action, which is a promising dimension to be explored by future research. The resulting dataset contains all municipalities in 367 microregions ever treated by affirmative action or SISU. They include municipalities directly treated by the policies (676) and indirectly treated (3,720).

3.4 Final database for analysis

We merge the school-level outcome data with the treatment level data at the microregion level. The resulting data contains school-level information on high-school seniors from 2010 to 2014 across municipalities treated directly and indirectly. Our resulting school-level panel data includes 16,043 high schools across 3,689 municipalities, 315 microregions, in all 26 states, plus the federal district. Our analysis is at the school level, with treatment variation at the microregion level. These schools cover a population of 5.8 million high school students.

Table 1 provides descriptive statistics for all schools and by public or private schools. Public high schools compose the majority of schools, accounting for 76 percent of all institutions in the data. We observe noteworthy differences across public and private schools for the primary outcomes of interest. The proportion of high school students dropping out is 10-12 p.p. higher among public school students than private school ones. Private school students are also more likely to demand college: the proportion of students present on exam day is about 30-34 p.p higher for private ones.

Public schools are, on average, larger than their private counterparts. The average enrollment is 430 for public schools and 170 for private schools. Moreover, around 28 percent of private high schools have less than 60 students, contrasting with only 5 percent of public high schools. Private high schools also have a higher socioeconomic index than public high schools. In the appendix, we provide an extended summary statistics table (Table B.1), including the proportion of students progressing and repeating a grade as well.

Table 1: Summary statistics

	All		**Public high school**		**Private high school**	
	2010	2014	2010	2014	2010	2014
HS dropout (all years)	0.14	0.13	0.17	0.15	0.05	0.05
HS graduate (seniors)	0.88	0.90	0.85	0.87	0.97	0.98
Present on the exam day (seniors)	0.47	0.58	0.40	0.50	0.71	0.84
School characteristics						
Average enrollment, all years	373.26	359.97	438.02	420.74	168.22	167.59
Small school ($<$ 60 students)	0.11	0.11	0.05	0.05	0.28	0.28
Socioeconomic level (Index)	5.37	5.37	4.91	4.91	7.01	7.01
Public school	0.76	0.76				
Number of Schools	16,387	16,387	12,223	12,223	4,164	4,164

Note: This table reports summary statistics at the school level. Public school includes schools administered at the federal, state or municipality level. Dropout variables are constructed based on individual level panel of students enrolled in high school. Present in exam is a variable representing the share of students in a school present in the ENEM exam. Present means student registered and took all four main exams (Portuguese, Natural Sciences, Mathematics and Social Sciences) and was not eliminated. Small school is a dummy indicating if total enrollment in the school is less than 60 students.

4 Empirical Strategy

Our goal is to estimate the effects of affirmative action on incentives to pursue schooling among high school students. We exploit nationwide temporal and geographical variation in the proportion of seats reserved to targeted applicants. We focus on outcomes at the school level: (i) the share of students dropping out of high school, and (ii) the share of high school

seniors graduating; (iii) the share of high school seniors present on the day of the ENEM exam - an exam widely used for college admissions and college financial aid.

4.1 Estimation

We estimate Equation (1) separately by private and public schools. The variable Y^j_{srt} refers to the outcome at school s, in a microregion r, and in year t. The superscript j refers to the set of schools included in the estimation and $j \in \{public, private\}$. The treatment intensity is measured by AA_{rt}, the proportion of college seats offered in a microregion r in year t allocated to affirmative action, which take values from 0 to 1. In the estimation, we included weights of the total number of students enrolled in the school to account for the aggregation across schools of different sizes. Errors are clustered at the municipality level.

$$Y^j_{srt} = \quad \alpha^j + \beta^j AA_{rt} + \gamma^j Z_{rt} + \phi_s + \theta_t + \epsilon_{srt} \tag{1}$$

We include school (ϕ_s) and year (θ_t) fixed effects. The school fixed effect controls for school time-invariant characteristics such as overall school quality and common factors that might affect demand for higher education in a locality. The year fixed effect controls for common national shocks such as policy announcements. We also control by time-varying characteristics (Z_{rt}) at the regional level. These controls include the proportion of seats in a microregion allocated in the centralized system (SISU), GDP per capita; share GDP by agriculture, industry, services, public administration, defense, education, health, social security; total spending per capita; education spending per capita; and percentiles of wages in the formal sector.

We estimate this equation separately by public and private high schools. This heterogeneity is motivated by policy design, with most affirmative action policies targeting applicants from public schools. Specifically, the federal law targets applicants from public high schools,

increasing public school students' acceptance probability while decreasing this probability for private school students.

Our identification strategy relies on the geographical and temporal variation in the share of college seats allocated to the affirmative action policy. Our parameters of interest, β^j, $j \in \{all, public, private\}$, represent the effect of a full adoption of AA - from zero to fifty percent of college seats reserved in microregion r - on the outcome Y^j_{srt}.

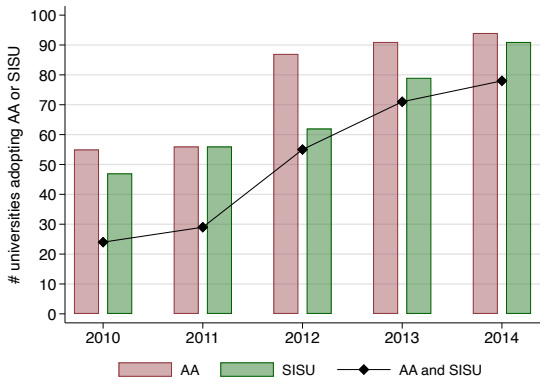
Affirmative action increases the probability of college attendance for public school students, and we expect the estimated effect to be positive for the targeted group. For the non-targeted group, private school students, although affirmative action reduces their chances of college acceptance, it does so only at public universities. Private universities continue to be relatively more accessible to private high school students. Therefore, we expect the effects of affirmative action on this group to be either negative or null.

4.2 Treatment variation

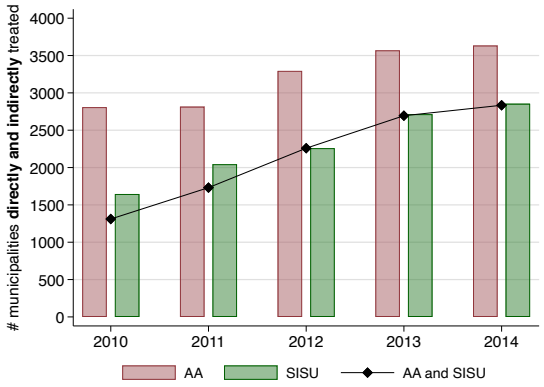
We exploit exogenous variation in the adoption of affirmative action policies across time and municipalities to identify our parameters of interest. We define a municipality as 'treated' if (i) the municipality has one or more universities adopting affirmative action; (ii) the municipality is within a microregion with one or more universities adopting affirmative action. The choice to include municipalities within a treated microregion in the analysis addresses the possibility that students in municipalities neighboring the ones directly treated might be indirectly affected by the policy. Simultaneously, the choice to exclude all microregions without any treated municipality is due to the geographic barriers for college attendance experienced by students in Brazil. For instance, roughly 90 percent of college students are enrolled in universities within their home state (Machado and Szerman, 2021), with the majority being from within the same microregion.

Figure 2: Number of universities adopting and municipalities treated by affirmative action or centralized admissions policies

(a) Adoption by universities



(b) Municipalities directly and indirectly treated



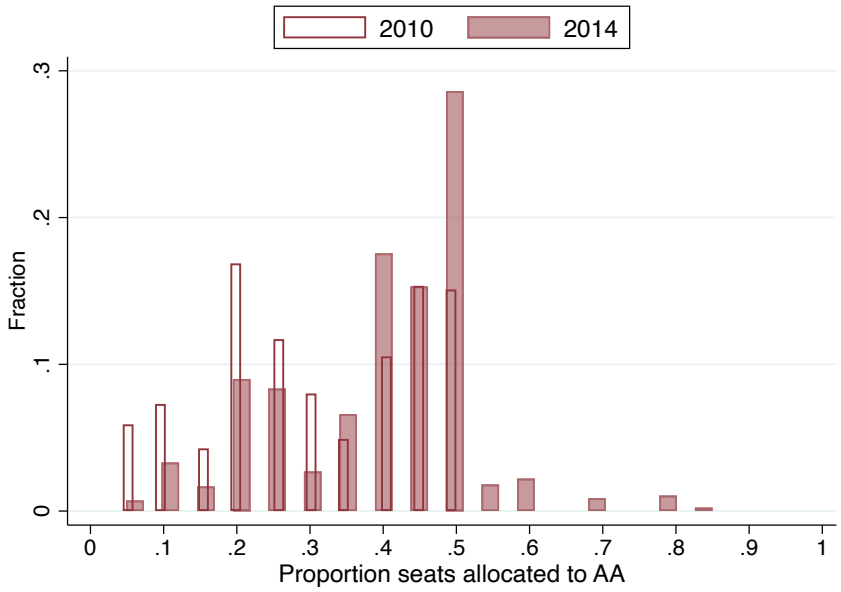
Note: These figures show treatment variation at the extensive margin. Panel (a) shows adoption at the university level. We report adoption by college or universities, excluding federal institutes of education. Panel (b) shows the number of municipalities directly and indirectly treated by the policies. Universities have different campuses. We define a municipality as directly treated if the adopting university campus is located at the municipality. We define a municipality as indirectly treated if the municipality is located in a microregion with a directly treated municipality. In the SISU and affirmative action data, the number of seats reserved or offered through SISU are reported for the academic year. Here, we adjust the year to be relative to the year high school students are treated with the information, that is, the same year as the ENEM.

Figure 2 reports the total number of universities adopting the policies (Panel (a)) and municipalities directly and indirectly treated (Panel (b)). From 2010 to 2014, the number of universities adopting affirmative action increased from 58 to 94, while municipalities in microregions with at least one university adopting affirmative action rose from 2,969 to 3,710. Figure 3 shows the intensive margin variation, the proportion of college seats allocated to affirmative action. This is the primary source of variation explored in our empirical strategy. We see an increase in the proportion of college seats per municipality allocated to affirmative action.

These figures also provide important insight into the variation induced by the federal affirmative action law enacted in 2012. As discussed in section 2, universities adopted affirmative action policies through state or university decree starting in 2002. Still, we see a

jump in the extensive margin in Figure 2a. This is induced by the 2012 federal law, which provides exogenous variation in the share of seats allocated to affirmative action, as reported in Figure 3. As of 2012, the federal government mandated all federal universities to reserve a minimum of 50 percent of college seats to affirmative action. The law had a three-year implementation period, but universities had yearly minimums, with 50 percent adoption to be implemented by 2015.

Figure 3: Percent of total college seats allocated to AA at the microregion level



Note: This figure shows variation at the intensive margin. Percent of seats allocated to AA is reported based on total seats in the microregion. All municipalities in a microregion are assigned the same treatment level. Total seats in a microregions is calculated based on all majors offered by all universities in a microregion.

Note that a few places allocated more than 50 percent of seats to affirmative action (Figure 3). In our analysis, we re-scale this variable by multiplying all values by 2. In this re-scaled variable, "full affirmative action adoption" means adopting at least 50 percent, and the places adopting 50 percent or more are assigned the value 1 for the ratio. The re-scaled affirmative action adoption variable ranges from 0 to 1.

An important threat to identification is the interaction of affirmative action with other contemporaneous policies. As discussed in section 2, during our analysis period, Brazil also

transitioned to a centralized college admissions system (SISU), which can directly affect students' behavior towards the national exam. When a university adopts SISU, ENEM becomes mandatory for college admissions, which increases the exam's stakes. Therefore, SISU can affect ENEM registration and the likelihood of a student being present on the exam day.

Figure 2 shows descriptive statistics on how the adoption of centralized admissions (SISU) evolves. Adoption of the SISU varies both at the intensive and extensive margins. In 2010, about 53 percent of universities adopting SISU also adopted AA, which increased to 85 percent in 2014. However, the overlapping relative to the number of directly or indirectly treated municipalities is high. To some extent, most municipalities affected by SISU are also affected by affirmative action. Our empirical strategy will account for the SISU roll-out by controlling for the proportion of university seats per municipality offered through the centralized system.

4.3 Exogeneity

The main identifying assumption for a causal interpretation of parameters β^j is that dynamics in the outcome variables for treated and control units are equivalent in the absence of treatment. The presence of school-fixed effects and time-varying microregion characteristics absorbs, respectively, all unobserved time-invariant and observed time-variant characteristics at a school or municipality that might be correlated with the outcome. However, the existence of additional time-varying unobserved characteristics could still be a threat to causal identification.

The current evidence suggests the federal law created a differential pattern of change in the AA policy by microregion and years, providing a plausible exogenous variation. In previous work analyzing the effects of AA and SISU on the enrollments of low-income students in public higher education in Brazil, Mello (2021) presents formal placebo tests showing that

the pattern of adoption of AA by institutions in the period 2010-2015 is not correlated with pre-trends in the enrollments of low socioeconomic status students in the public universities. The author argues that institutions do not adopt AA as a response to changes in the student population's demographic characteristics observed one or two years before implementing the policy. Instead, the within-institution variation in AA adoption during 2010-2015 occurs primarily due to the 2012 federal law, which externally mandates that all federal institutions adopt AA or adapt their ongoing AA policy.

Our paper relies on the same variation used by Mello (2021). Instead of exploring within-institution changes in AA adoption, we aggregate the treatment of universities located in the same microregion to create a measure of exposure for high school students. In our case, the exogeneity assumption for a causal interpretation of parameters β^j is that within-microregion variation in AA adoption is not correlated with changes in high school students' pre-college outcomes. This could be considered a less conservative assumption than the one tested by Mello (2021). Since institutions do not adopt AA in response to changes in the composition of their student body in previous years, it is unlikely that they would do so in response to variations in the behavior of high school students of their microregion.

5 Results

Table 2 show estimated results of Equation (1) for the different outcomes. The coefficient of interest (β) refers to the short-term effects of full adoption of affirmative action. As discussed in the previous section, the "$\%AA$" variable is re-scaled, such that full adoption means allocating at least 50 percent of seats to the policy.

Columns (1) and (2) show results for high school dropout rates for public and private high school students, respectively. Results show that affirmative action had opposite effects across these two groups. AA adoption reduces dropout by 1.5 p.p. or 8.9 percent for public school students. For their private-school counterparts, AA seems to increase dropout rates

by 0.5 p.p. or 10 percent relative to baseline 2010 average, although the coefficient is only marginally statistically significant. For high school graduation (columns 3-4), effects are detected among public school students, increasing graduation rates by 2 p.p. or 2.3 percent.

Taken together, these results show that affirmative action affects pre-college demand for schooling by altering the incentives for students to progress through high school education. The gains are concentrated among public school students, targeted by affirmative action, primarily by decreasing dropout rates. The adverse shocks on their college acceptance probabilities for private school students are not enough to lower graduation rates among high school seniors. Instead, it affects their progression, with an increased probability of dropout.

Table 2: Effects of AA on high school dropout, graduation and demand for college

	High School Dropout		**High School Graduation**		**Present on exam day**	
	(1)	(2)	(3)	(4)	(5)	(6)
	Public	Private	Public	Private	Public	Private
% AA	-0.015***	0.005*	0.020***	0.003	0.041***	-0.055***
	(0.00)	(0.00)	(0.01)	(0.00)	(0.01)	(0.02)
Observations	60705	19240	60705	19240	60705	19225
R^2	0.746	0.574	0.702	0.518	0.839	0.751
Time varying ctrl	x	x	x	x	x	x
School FE	x	x	x	x	x	x
Year FE	x	x	x	x	x	x
Mean DV (2010)	0.169	0.047	0.846	0.974	0.397	0.708

Note: This table reports results for the estimation of Equation 1 for the outcome measuring the share of high school students dropping out of school - including 1st, 2nd or 3rd year (seniors) -, and the share of students graduating from high school (calculated among seniors). Dropout is defined as a student not found in the census in the following year. The estimation is weighted by the total number of students enrolled in the high school to account for different school sizes. Results are robust to estimations without weights and are provided in the appendix. Errors are clustered at the municipality level.

Another set of outcomes we investigate refers to whether high school seniors took the ENEM. This exam is widely used for college admissions, and here we interpret the demand for this exam as a demand for higher education. Columns (5) and (6) in table 2 show the estimates of the effects of affirmative action full adoption on the proportion of high school seniors present on the exam day. Again, the results show the differential effects of affirmative action by targeted and non-targeted students. Affirmative action policies positively affect

public high school students, increasing their ENEM take-up by 4.1 p.p. or 10 percent. This contrasts with the adverse effects on private school students, with the share taking the ENEM reducing by 5.5 p.p. or 7.7 percent.

These opposite effects of affirmative action on demand for college for public and private schools are consistent with predictions from models of human capital accumulation in the presence of a change in the expected probability of college admission Bodoh-Creed and Hickman (2018). For public school students, affirmative action increases their chances of college acceptance, increasing their returns to taking the exam in the first place. For private school students, affirmative action has the opposite effect, negatively affecting their college acceptance chances. For many students on the margin, this change in the probability of college acceptance is sufficient to move them towards choosing not to take the exam at all.

We do not have data to estimate whether this reduction in the share of students taking the ENEM converts to lower levels of college enrollment. This connection is not expected to be 1:1 since high-income students can attend a private university without needing to take the ENEM. Not taking the ENEM mostly eliminates their chances at a public institution and applying for financial aid (for which they are less likely to qualify based on their high socioeconomic status).

5.1 Heterogeneity: Socioeconomic Level

The differential effects of affirmative action by type of school are directly related to the targeted and non-targeted groups by the policy. Due to the policy design and financial barriers to college, we also expected heterogeneous effects by socioeconomic status.

The AA policy targets students for public schools, with sub-quotas for students from public schools that are also low-income. However, college attendance is costly even with free tuition, with few options for financial aid. That means high-SES students from public schools have better resources to benefit from the policy. For private school students, low-SES are

more likely to be hurt by the policy, and high-SES have more outside options beyond public colleges.

In Table 3, we provides estimates of Equation (1) separately by socioeconomic status. We find interesting heterogeneity results from this exercise. Among public school students, lower dropout results are mostly concentrated among low-SES students, but graduation results among high-SES are twice that of low-SES. When we look at the demand for college, results are driven by low-SES applicants, for which the probability of acceptance increased more substantially. For private school students, the negative results on demand for public colleges are mostly driven by high-SES students, given their more varied set of outside options. The large negative effect of AA on ENEM take-up rates of high-SES students likely reflects an increase in preferences of this group for private higher education, both due to their lower probabilities of admissions and to the expected change in the demographic composition of public colleges.

Table 3: Effects of AA on high school dropout, graduation and demand for college, across different levels of average socioeconomic status in the school

	HS Dropout (All years)		**HS Graduation** (Seniors)		**Present in Exam** (Seniors)	
	(1)	(2)	(3)	(4)	(5)	(6)
	Panel A - Public High Schools					
	Low-SES	High-SES	Low-SES	High-SES	Low-SES	High-SES
% AA	-0.013***	-0.009*	0.013*	0.024***	0.054***	0.007
	(0.00)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Observations	29225	29355	29225	29355	29225	29355
Mean DV (2010)	0.189	0.146	0.841	0.850	0.368	0.443
	Panel B - Private High Schools					
	Low-SES	High-SES	Low-SES	High-SES	Low-SES	High-SES
% AA	0.006	0.006	0.005	0.002	-0.020	-0.089***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.02)	(0.02)
Observations	8345	10895	8345	10895	8335	10890
Mean DV (2010)	0.052	0.044	0.971	0.977	0.728	0.693
Time varying ctrl	x	x	x	x	x	x
School FE	x	x	x	x	x	x
Year FE	x	x	x	x	x	x

Note: This table reports results for the estimation of Equation 1 for the outcome measuring the share of high school students dropping out of school - including 1st, 2nd, or 3rd year (seniors) -, and the share of students graduating from high school (calculated among seniors). Results are estimated separately by socioeconomic status and type of school. Socioeconomic status is defined at the school level - information provided by the ministry of education. We create a dummy that equals one if the school is above the median and 0 if the school is below the median of the socioeconomic index. Dropout is defined as a student not found in the census in the following year. The estimation is weighted by the total number of students enrolled in the high school to account for different school sizes. Results are robust to estimations without weights and are provided in the appendix. Errors are clustered at the municipality level.

6 Conclusion

This paper investigates how affirmative action policies in higher education can have effects that go beyond their direct impacts on college enrollments and attainment. By changing the college acceptance probabilities differently for targeted and non-targeted groups, AA is also expected to lead to heterogeneous impacts on students' incentives and choices. Shedding

light on the extent and mechanisms behind these effects is essential for a more comprehensive understanding of AA's welfare effects and a better policy design.

We rely on exogenous variation introduced by local and nationwide affirmative action policies in Brazil. We investigate how AA differently impacts demand for schooling for public and private school students. Our findings suggest that AA increases schooling incentives for public school students, culminating in higher persistence rates and increased college demand. Importantly, we find positive effects of AA on human capital accumulation even considering that universities in Brazil have adopted affirmative action policies for a decade before our study period. Still, our empirical strategy can detect effects induced by marginal changes in the policies' intensity. We should expect larger dynamic AA effects on human capital accumulation when allowing for differential effects by policy duration. A broader understanding of AA's dynamic effects on pre-college behavior is an important topic for future research.

Even though AA does not affect private school students' persistence rates, it decreases their demand for college. This suggests that an increase in competition for college seats for this group drives away some private school students from taking the ENEM exam. Different mechanisms might be behind this effect. First, these students could be delaying their college application by one year instead of trying as high school seniors. Preparatory courses focused on college entry exams are a standard option in Brazil for people seeking higher education. Second, some of these high school students may be displaced to the private higher education market by going to private colleges that do not require the ENEM in their admission processes. In any case, by not taking the ENEM, a student is worse off by considerably shrinking their college choice set. Besides, without ENEM scores, they cannot apply for government scholarships and financial aid. Government programs such as ProUni (*Programa Universidade para Todos*) and FIES (*Fundo de Financiamento ao Estudante do Ensino Superior*) provide scholarships and financial aid for low-income students, but all require a minimum ENEM score for eligibility. Uncovering these potential mechanisms is also an important theme for future research.

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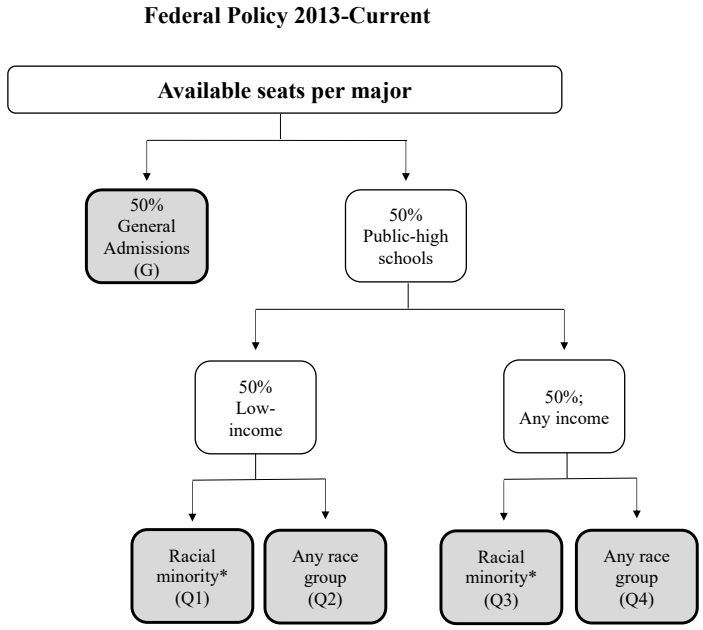
A Additional figures

Figure A.1: Allocation of minimum seats according to the 2012 federal affirmative action law



* proportional to the respective share of black and indigenous in the state according to the most recent census.

B Additional tables

Table B.1: Summary statistics, extended

	All		Public high school		Private high school	
	2010	2014	2010	2014	2010	2014
High-school, 1st year						
Pass from 1st to 2nd year	0.69	0.71	0.63	0.66	0.86	0.86
Repeat 1st year	0.14	0.13	0.16	0.15	0.08	0.08
Drop out of high school	0.18	0.16	0.21	0.19	0.07	0.06
High-school, 2nd year						
Pass from 2nd to 3rd year	0.76	0.77	0.72	0.73	0.90	0.90
Repeat 2nd year	0.08	0.08	0.10	0.09	0.03	0.03
Drop out of high school	0.15	0.15	0.18	0.17	0.07	0.07
High school, 3rd year (seniors)						
Graduate High School	0.88	0.90	0.85	0.87	0.97	0.98
Repeat 3rd year	0.06	0.05	0.07	0.06	0.02	0.02
Drop out of high school	0.06	0.05	0.08	0.06	0.00	0.00
Demand for college	0.47	0.58	0.40	0.50	0.71	0.84
School characteristics						
Average enrollment, all years	373.26	359.97	438.02	420.74	168.22	167.59
Small school ($<$ 60 students)	0.11	0.11	0.05	0.05	0.28	0.28
Socioeconomic level (Index)	5.37	5.37	4.91	4.91	7.01	7.01
Public school	0.76	0.76				
Number of Schools	16,387	16,387	12,223	12,223	4,164	4,164

Note: This table reports summary statistics at the school level. Public school includes schools administered at the federal, state or municipality level. Pass/repeat and dropout variables are constructed based on individual level panel of students enrolled in high school. For students passing and repeating, it includes students staying in the same or moving to a different school. Register/Present in exam is a variable representing the share of students in a school registered/present in the exam. Present means student took all four main exams (Portuguese, Natural Sciences, Mathematics and Social Sciences) and was not eliminated. Small school is a dummy indicating if total enrollment in the school is less than 60 students (bottom 10th decile).