The Last Mile: Needs-Based Aid and Persistence for Students in Elite Universities

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Abstract

We estimate the effects of needs-based student aid on persistence in the University of Sao Paulo - Brazil's highest ranked institution and largest public university - in a cohort exposed to a sharp increase in low-income and non-white enrollment brought about by affirmative action. Exploiting the sharp discontinuity in the eligibility criteria to a stipend equivalent to around a third of the full-time minimum wage, we find that undergraduate students that received the benefit in their first-year increased their odds of persistence to the fourth year by 56% and reduced by 33% their chance of dropping out.

Keywords: Regression Discontinuity, Student Aid, Persistence

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The distribution of educational opportunities carries significant implications for societal inequality and intergenerational mobility (Jerrim and Macmillan 2015, Golley and Kong 2013). In many countries, admission to higher learning institutions hinges wholly or in part on a standardized entrance exams. However, even assuming equal access to these tests, candidates from economically disadvantaged backgrounds face substantial hurdles in securing admission. Limited financial resources often restrict their ability to invest in educational support services or exam preparation courses, placing them at a distinct disadvantage (Buchmann et al. 2010, Jerrim and Vignoles 2015). Moreover, even for those students able to overcome these obstacles, the financial strains encountered during their studies present another challenge to obtaining a college degree (Stewart et al. 2015)

Many national, sub-national and university-level student aid programs exist to lower the costs of a tertiary education to candidates. Programs in this vein provide benefits such as cash grants, student loans and subsidized accommodations. The criteria for eligibility for the benefits can be fully needs-based - dependent on the most part on household income - or also partly based on academic merit, taking prior achievements and future potential into account. Previous research has found that needs-based financial aid in the form of grants or cash transfer, especially when coupled with academic requirements, are more effective than tuition reductions or loan subsidies (Dynarski and Scott-Clayton 2013)

Attempts to robustly estimate the effect of needs-based programs depends in large part on their eligibility criteria. Ideally, the concession of the benefit should have no relation to any student characteristics besides those pertaining to financial condition - such as race, gender, academic ability - as those could also impact academic performance directly. Additionally, there might be unobserved differences within eligible students - such as greater attentiveness or determination - that impact the decision to actually apply to the benefit.

Saccaro et al. (2020) investigated the impact of the Brazilian National Program for Student Assistance (PNAES), which offers cash transfers to economically disadvantaged students enrolled in federal universities. Employing Differences-in-Differences estimations and controlling for covariates, the study discovered that the program reduces the likelihood of dropping out by 23%. However, information regarding which eligible students effectively applied for the benefit, their

specific family income, and the academic abilities of applicants was unavailable. Moreover, as each institution had the autonomy to establish its eligibility criteria, there's a possibility of unobserved biases in the selection process.

A popular strategy to deal these aforementioned issues involves exploiting discontinuities in the probability of treatment when a certain continuous variable defines eligibility - such as the household income level - within a sample restricted to applicants to student aid. Bettinger (2004) used the discontinuity in Expected Family Contribution (EFC) for eligibility to Pell Grants to examine its impact on drop-out rates, finding that a US$1,000 increase in Pell Grants leads to a 4 percent reduction in the likelihood that students withdraw. Similarly, Castleman and Long (2016) used cutoffs in the EFC for students for a US$1,300 Florida based grant that supplemented Pell Grants, finding the eligibility to increase the probability of enrollment and finishing a degree within six years. Fack and Grenet (2015) examine the french *Bourses sur critères sociaux* which awards grants nation-wide based on eligibility tiers determined by a combined household income and distance to university metric - finding that eligibility to a €1500 annual grant to increase enrollement by 4%, and persistence to the second year by 4.4%. In the case for Colombia, Melguizo et al. (2016) have shown that subsidized student loans increase the likelihood of poor students enrolling in colleges by 16% and reduced drop-out rates by around 5%.

Our paper presents two main contributions the literature on needs-based student aid programs. The first is that this is to our knowledge the first study to robustly estimate the effect of a cash grant student aid program in a developing economy, since previous efforts to study the causal effects of aid programs, according to a recent systematic review, have been restricted to the United States and Europe (Nguyen et al. 2019). Only 15% of adults in Brazil aged 25-34 had a college degree in 2015, versus the 42% OECD average (OECD 2012). Standard human capital theory would suggest that the effect of financial assistance would depend on the expected returns from a college degree vis-a-vis dropping out or switching to a different institution. Since the returns to a college education in developing countries are larger, assistance programs would tend to have a greater impact on students decisions as well. This would be especially the case considering that alternative forms of tertiary education in Brazil often charge tuition and

are on average of lower quality than the University of São Paulo.

We also believe this work can complement the growing literature on the effects of affirmative action in higher education admission on social mobility and inequality. These include works such as Bagde et al. (2016) on caste-based reserved slots for certain castes in Indian Engineering colleges, and Mello (2022) and Otero et al. (2021) on the Brazilian affirmative action policies that favors students from public high-schools. As underrepresented groups are more likely to suffer from financial pressures to complete their studies, persistence policies impact the effectiveness of affirmative action in lessening post-graduate and therefore inter-generational inequalities. This is especially so in the most prestigious universities, since they attract candidates from many other regions of the country, have more stringent academic requirements and are located in areas with a higher cost of living. We document the effects of needs-based aid for a cohort exposed to a sharp increase in low-income and non-white enrollment brought about by affirmative action policy.

In order to estimate the effect of financial assistance on student outcomes, we exploit the sharp discontinuity in the eligibility criteria to needs-based aid to first-year students who gained admission in 2018 to the University of São Paulo (USP) - Brazil's largest public university and highest ranked institution. Applicants to student assistance needed to submit documents and answer a socioeconomic questionnaire to verify their socioeconomic condition after formalizing their enrollment in the university. This resulted in each student receiving a vulnerability score, whose value assigns them into tiers eligible to certain benefits. Applicants do not know the formula for this score, their own classification nor the cutoff for each tier.

Employing a Fuzzy Regression Discontinuity (RD) exploiting the sharp cutoffs between tiers, we estimate that undergraduate students that received a monthly stipend - equivalent to around third of the minimum wage - increased their persistence to the fourth year by 56% and reduced by 33% the incidence of dropping out if compared to applicants in the same course (major) who were not awarded the benefit. A number of robustness tests are conducted to confirm the validity of our identification strategy and results. We interpret these findings as evidence of the impact of financial assistance in improving the academic outcomes of low-income students, indicating that financial pressures are still a significant barrier preventing

study completion even for very qualified candidates at elite institutions.

Since many low-income students cannot manage to fulfil all requirements of their course while working to support themselves, nor access enough credit to finance their present living costs, poorer students might be prevented from continuing in their courses even when doing so would substantially increase their lifetime earnings. Our estimates show how needs-based assistance for enrolled students can complement existing affirmative action policies to lessen the inequality of historically underrepresented groups in the attainment of an elite college education and highly paid work opportunities.

The remainder of the paper is structured as follows. Section I covers the institutional background of higher education in Brazil, the University of São Paulo's affirmative action policies, its student aid program and eligibility criteria. Section II relates the sources of data used and how the variables were calculated. Section III presents our empirical strategy and shows robustness tests for the internal validity of our Regression Discontinuity (RD) estimation. Section IV presents the results and Section V concludes.

1 Institutional Background

The University of São Paulo (USP) is the flagship university of the state of São Paulo and the largest public university in Brazil. The USP is known for its high academic standards, research facilities and faculty expertise, reflected in the fact that it is currently the highest ranked placing learning institution in several university rankings for Brazil and Latin America as a whole.[1] USP alumni have had a large influence on Brazilian business and politics, including 30% of the country's Presidents and 31% of Supreme Court Justices. The university also has an outsized role in research output, producing alone about a quarter of Brazil's indexed research articles [2]

[1]The USP is the top ranked Latin American university in 2023 according to the Webometrics Ranking of World Universities, QS World University Rankings and Times Higher Education

[2]http://www.usp.br/jorusp/arquivo/2005/jusp726/pag03.htm
https://www5.usp.br/noticias/sociedade/conheca-os-presidentes-do-brasil-que-estudaram-na-usp/
https://oglobo.globo.com/politica/faculdade-de-direito-da-usp-pode-ter-13-presidente-da-

The main campus and headquarters of the USP is situated in the *Butantã* neighbourhood in the city of São Paulo, covering around 3.7 km^2 (914 acres) of land. Between 80 to a 100 thousand people work or study in this campus, including over 10 thousand new enrolling graduate and undergraduate students per year in all major areas of learning.[3] This campus contains the Housing Complex of the Univesity of São Paulo - hereafter CRUSP, which houses graduate and undergraduate students. It has a capacity of around 1200 and does not charge rent or utilities to its inhabitants.

Having a degree from the USP has a significant impact on labor market outcomes. In 2018, the year we examine, a worker with a bachelors degree of the university of São Paulo had a 141% wage premium versus one with only a high-school degree, even when controlling for personal characteristics such as age, experience, region, contract type and specific occupation. When comparing an alumni from USP to the general population with a bachelors degree, there is still a 29% adjusted earnings premium - which is larger the overall tertiary education wage premium in some developed countries (Azzoni and Vassallo 2022, Strauss and De la Maisonneuve 2009)

Although the USP is a public institution and does not charge tuition, its students have historically come from families with high socioeconomic status. This was also generally the case for the vast majority of the best universities in Brazil, which are also public (whether state or federal) and free of charge to students (Mello 2022). Admission to public universities is determined entirely through an admissions test, known in Brazil as *Vestibular Exams*. These include the National Exam of Secondary Education (ENEM) which allocate slots for federal higher learning, as well as exams operated by universities directly such as Foundation for Vestibular to the University of São Paulo (FUVEST) that determines entry into the USP.

In principle, admission purely through standardized tests might appear to be less discriminatory than selections which consider students' high-school quality

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[3]https://www.puspc.usp.br/wp-content/uploads/sites/159/2016/08/Campus-USP-da-Capital.pdf

https://uspdigital.usp.br/anuario/AnuarioControle

and extracurricular activities. However, since richer households are able to afford private schooling - which is on average of higher quality - these students tended to occupy the majority of slots at the most prestigious institutions, even though the great majority (87% in 2012) of Brazilian high school students are in the public system (Travitzki et al. 2014, INEP 2012). This long-standing inequality of access to higher education led to several initiatives at the state, federal and institution level to adopt affirmative action policies that increased the entry of historically underrepresented groups in higher education.

The USP implemented in 2007 the Social Inclusion Program (Inclusp), which awarded a bonus percentage to the final FUVEST admission score of applicants who i) had attended public basic schooling or ii) were black, brown and indigenous. Likewise, the Federal government of Brazil established the Quota Law (No. 12,711) in 2012, which determined that, until 2016, half of the slots in federal universities would be reserved for candidates who attended public high-schools. Within this 50% of reserved slots for students who attended public high-school, the Quota law establish four subcategories for i) Only public schooling needed ii) Low-income, with household income of less than 1,5 per capita minimum wage iii) black, brown or indigenous iv) black, brown or indigenous as well as low-income. The proportion of reserved slots which take racial identification into account equals those group's prevalence in the university's state.

These aforementioned changes in the student body demographics brought about by affirmative actions were expected to increase demand for student aid. The *Programa de Apoio à Permanência e Formação Estudantil* (Program for Support of Student Persistence and Development, hereafter PAPFE) is the student aid program of the USP and the largest student aid scheme operated by an university in Brazil. It is responsible for overseeing the distribution and implementation of several benefits, in accordance with socioeconomic needs, the two most important benefits being slots in the aforementioned CRUSP as well as a monthly stipend. Although this latter benefit is nominally considered to be for housing costs, it functions in practice as a cash transfer since the value is deposited directly into the beneficiary's bank account with no conditions for its use.

In 2018, the deadline to confirm enrollment in the University of São Paulo was February 16th, while the application to PAPFE for incoming students opened

three days later. The results were announced only in May - over a month after the start of classes. Therefore, we can be sure not only that both eligible and not eligible students were already enrolled, but that both were expected to be already taking classes before the benefit was awarded.

In order to apply to PAPFE, the student must submit documents relating to i) Records of Previous levels of study and any financial assistance received ii) Proof of Residence iii) Household's financial resources iv) medical condition v) Family Composition. After the documents are submitted, the student is interviewed by a social worker, who in turn fills a questionnaire with a standard list of question regarding the socioeconomic condition of the student. This questionnaire has weights placed on the different answers for the questions, based on a formula which determines the final score. Although household income is the main determining factor, components such as distance to the university, parent's educational attainment, medical condition and type of high school attended also influences to a lesser degree the students position.

After calculating students' scores, they are categorized into different tiers of priority, determining eligibility for various benefits. At this stage, students are unaware of the weights assigned to individual questions, the cutoff values for each tier, or their own scores. The tiers, listed from least to most vulnerable, are as follows:

- P2: Moderately Vulnerable - Eligible for free meals in the university cafeteria and coupons for books
- P1-S: Very Vulnerable - Eligible for P2 benefits, plus a monthly stipend of R$ 400
- P1-H: Very Vulnerable - Eligible for P2 benefits, plus either a monthly stipend of R$ 400 **OR** Free University Housing

Applicants are required to indicate which benefits they wish to apply for, potentially resulting in a student not receiving benefits which they are eligible to, in the case they did not request it. Applicants must choose between either requesting the monthly stipend or a slot in the university housing complex CRUSP, which

waives rent and utilities. However, free housing has a higher vulnerability score requirement than the stipend, essentially serving as a distinct tier. If a student requests housing assistance but falls into the P1-S tier, they will receive the stipend instead. Conversely, a student who requests the stipend but falls into the P1-H tier will still receive it. All forms of assistance must be renewed annually, with the renewal process being simpler than the initial assessment for incoming students, involving resubmission of income statements, proof of residence, and enrollment in a minimum number of credits.

2 Data and Descriptive Statistics

The data used comes from three sources, which were compiled by the Pro-rectory of Undergraduate Affairs (Pró-Reitoria de Graduação) of the University of São Paulo. The first source is the Jupiterweb System, which administers all records relating to undergraduate performance for students entering the main USP campus from 2011 to 2018, such as major, grades obtained and degree completion. It is worth noting that the university of São Paulo automatically terminates the enrollment of any students who i) fail to enroll in any credits for two semesters in a row or ii) Does not obtain at least 20% of the credits enrolled during the last two semesters. Since it is also mandatory for students to enroll in at least 12 weekly classroom hours in every semester, persistence in the same course in which the student was admitted in implies taking credits and progress towards degree completion. We dropped the Jupiterweb records with exceptional outcomes for students from the sample, such as student death or expulsion.

The second source comes from the two admission tests which confer entry to the University of São Paulo, the University Foundation for Vestibular (FUVEST) or the National Exam of Secondary Schooling (ENEM). Both forms of admission ask applicants to answer a questionnaire on their personal characteristics. From this, we are able to obtain data not only on the student's test scores, but also their self-reported race, gender and household income before admission. The third source comes from the PAPFE records of enrolling students in 2018, which provides information on the vulnerability scores and benefits the student received.

2.1 Affirmative Action Policies at the University of São Paulo

The Affirmative Action policies for entry into the University of São Paulo from 2011 to 2018 can be broadly divided into two main periods. The first, from 2011 to 2015, was based on Inclusp system that awarded a bonus score to the FUVEST admission test for applicants who were black, brown on indigenous (BBI) or had come from a public elementary and/or high-school education. The exact percentage added to a student's score depended on eligibility. The maximum test score bonus varied gradually from 12% in 2011 to 25% in 2014 onwards.

In the second period, in the years from 2016 to 2018, the Inclusp bonus was changed to be a fixed increase to test scores regardless of how well the benefited applicant performed. Also beggining in 2016, a portion of slots for admission would henceforth be available through the federal National Exam for High Schools (ENEM). Furthermore, some of these ENEM slots were reserved exclusively for students from public schools, as well as public school students who self-identified as Black, Brown or Indigenous - within the framework of the Federal Quota Law. Table 1 shows how each of the two kinds of benefits changed from 2011 to 2018.

Table 1: Affirmative Action Policies for the University of São Paulo

Year	Maximum Bonus %	Bonus Type	Public School Slots %	Racial Slots %
2011	12	Proportional	0	0
2012	15	Proportional	0	0
2013	20	Proportional	0	0
2014	25	Proportional	0	0
2015	25	Proportional	0	0
2016	25	Fixed	5.7	0.3
2017	25	Fixed	17.3	7.4
2018	25	Fixed	20.6	10.2

Note: The proportion of Public School Slots and Racial Slots only refers to the proportion of incoming students in the Main USP Campus, not the USP as a whole. For a complete overview of criteria, see Pereira (2019)

Figure 2 illustrates the transition between the two aforementioned periods with a dasehd line, showing the increase in the percentage of reserved slots through the ENEM exam as a percentage of all new enrollments. Additionally, it provides information on variation of racial composition and mean income for the main USP campus student body. The graph shows how the quota slots coincided with a significant reduction in mean income of the USP enrolling student as well as increase in the prevalence of BBI self-identification.

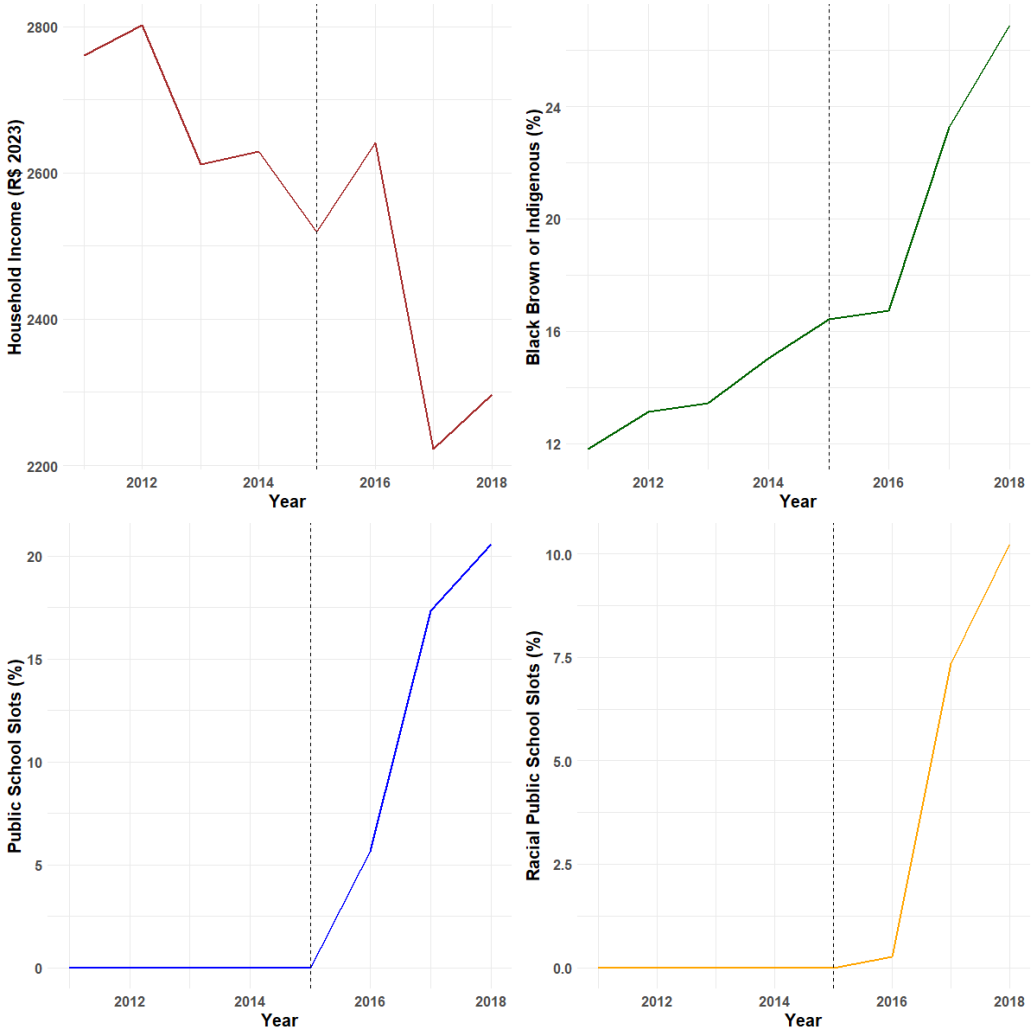


Figure 1: Demographic Changes and Reserved Slots of the Student Body at the USP

Notes: Data on racial identification is limited to valid answers on pre-enrollment student questionnaires, meaning there is data available for around 70% of the entire 2011-2018 sample of students in the main USP Campus.

In 2016 the ENEM reserved slots were available essentially only to public schooled students, but with no further conditions regarding their racial or financial situation. That year does not appear to change the student body composition. Un-

like FUVEST, whose applicants in great majority were from the São Paulo State, ENEM is taken by students in all regions in Brazil and applicants can choose which university and major to enter after they already know their result. Therefore, it is possible that these public school-only slots were captured by the highest scoring, relatively richer public school applicants of other regions who preferred the USP to local universities . Additionally, there is evidence that, since the passing of Quota Law in 2012, students from many households had switched from the private elementary schooling to public high-schools, anticipating to gain the benefits associated with affirmative action (Mello 2023).

A significant change in student demographic does however occur in 2017, which coincides with public school quotas with a racial component being implemented. This is also consistent with the proposition that adopting the criteria of public-only reserved quotas benefited mostly richer public-school applicants.

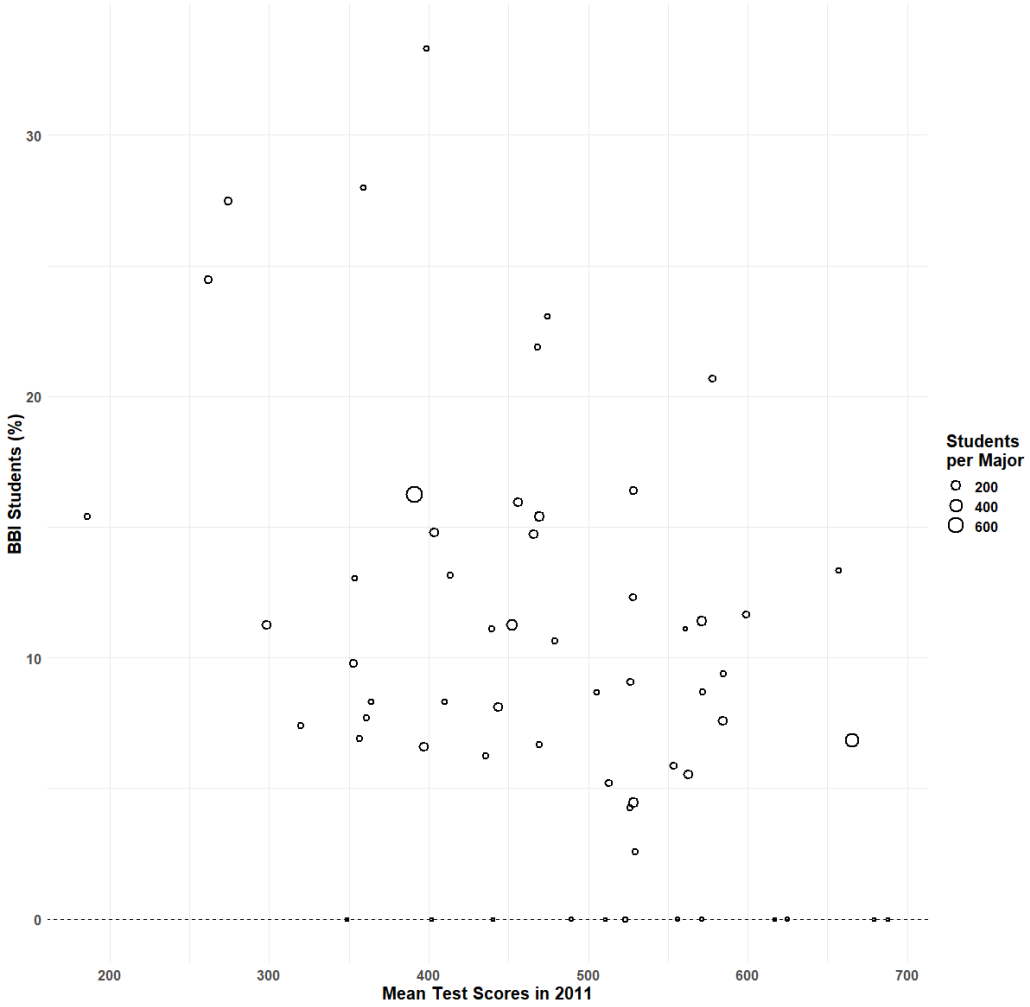
As mentioned before, there are different admission cutoff scores for each major, while there exists very limited possibilities of switching courses (ie. from economics to math) midway through studies. Therefore, due to greater competition for admission into the most prestigious majors, Brazil's inequality in higher education therefore was reflected not only in the over-representation of white and higher income students in the most prestigious universities relative to the general population, but also in their prevalence in the most prestigious areas within said institutions.

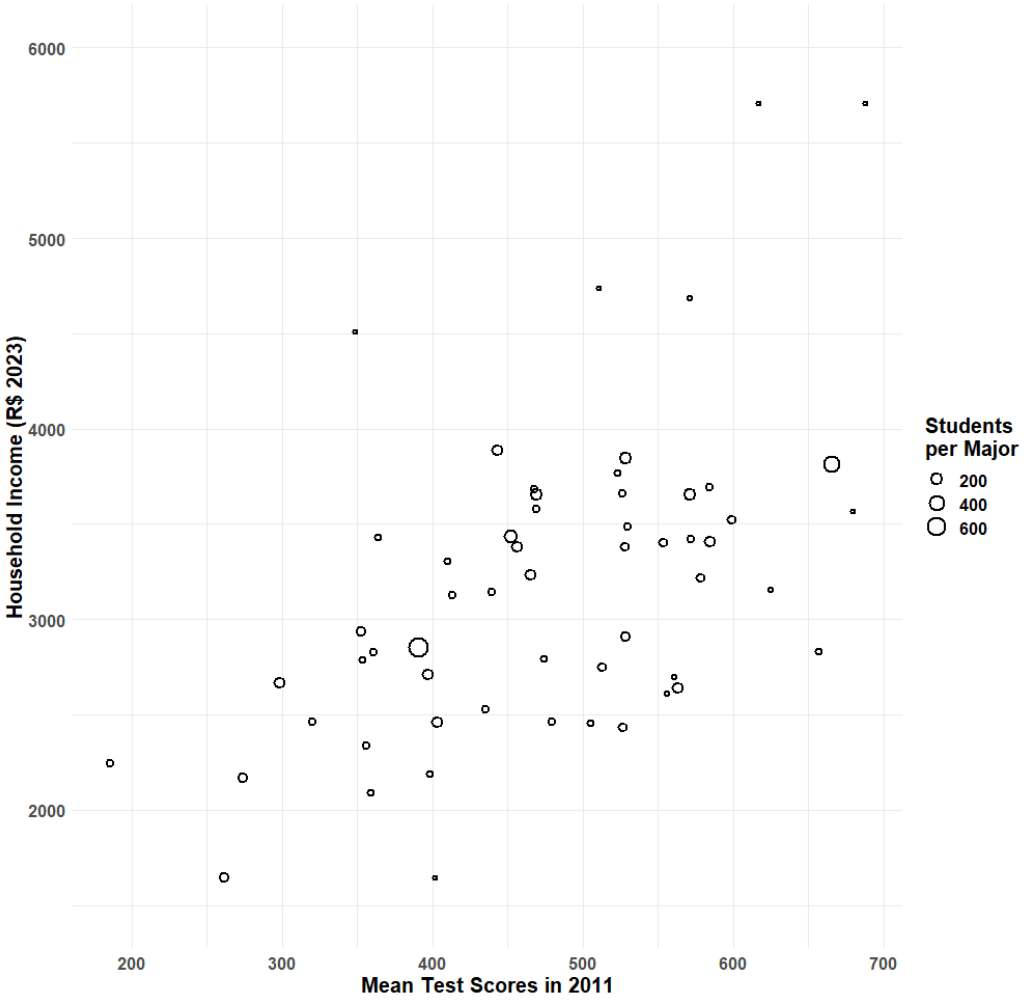
The effects of affirmative action policies would be expected to differ depending on the this heterogeneity. Majors which had a greater preponderance of richer white students could be expected to be impacted in a greater degree by the changes. Likewise, since these kinds of majors were historically more prestigious, we would expect the policy to have a greater effect for courses with greater admission score cutoffs.

To examine the heterogeneity in each major's student body prior to the increase in affirmative action pressures, we compute the major-specific mean test scores, household income and proportion of Black, Brown and Indigenous (BBI) in 2011. Figure 2 shows how major-specific test score is negatively correlated with racial diversity. Majors with higher admission requirement tended to be less racially diverse with very few self-declared Black, Brown or Indigenous students,

with some majors having none at all. Similarly, Figure 3 shows how the majors with high test scores in 2011 also had students of higher household incomes.

Figure 2: Disparity in Major Test Scores and Racial Diversity in 2011



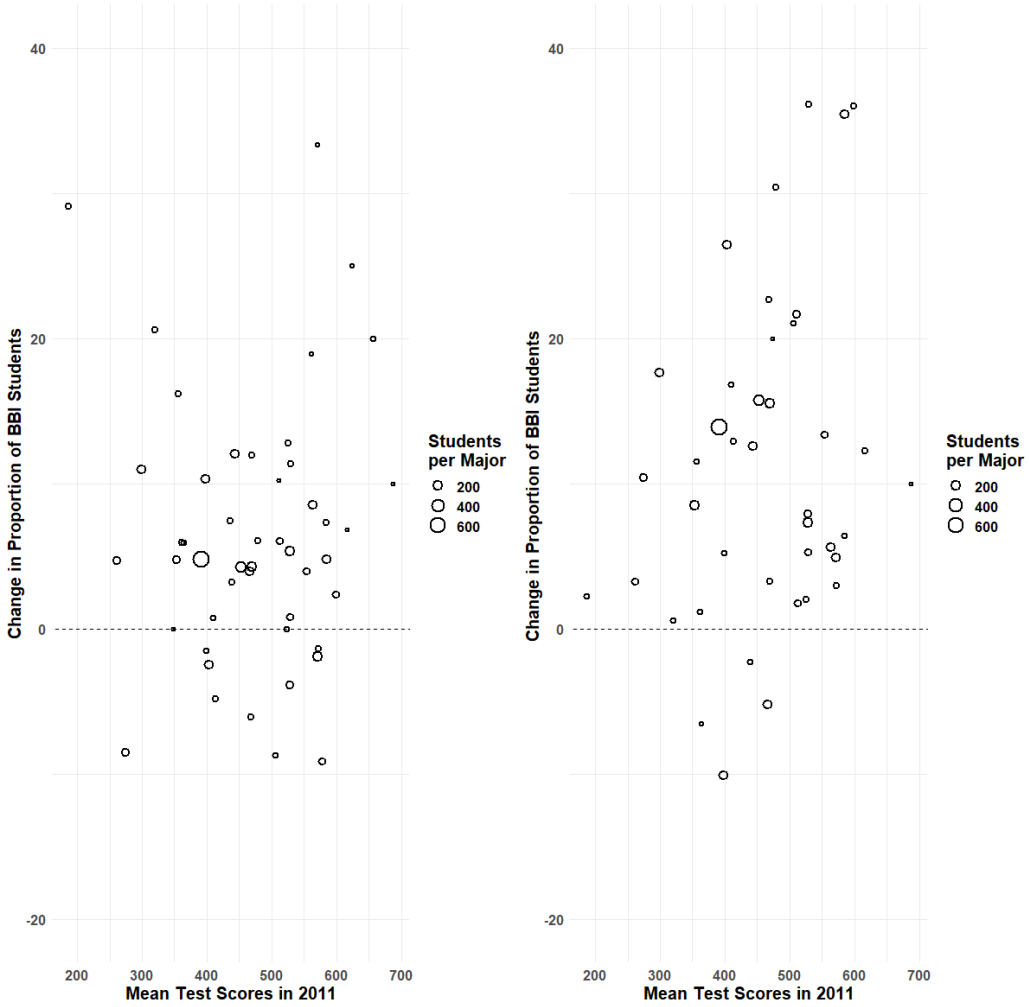


Notes: Data on Income is limited to valid answers on pre-enrollment student questionnaires, meaning there is data available for around 93% of the entire 2011-2018 sample of students in the main USP Campus.

To see how each kind of affirmative action policy (reserved slots or bonus points) impacted entry of non-white or asian students into the USP in different courses, we estimated the variation in BBI presence for both periods. Figure 4a shows each major as a point, where the position on the X axis shows the mean test score of enrolled students in 2011, while the Y axis represents the variation in the percentage of BBI enrolling students from 2011 to 2015. When the Bonus

System was active from 2011 to 2015, the average number of self-identified BBI students in each course increased by 56% - from around 10% of students to nearly 16%. This effect was evident both in courses with both high and low admission scores. Figure 4b shows how in the second period, when the reserved quota system was active, there was a 74% overall increase in BBI self-identification - which reached 27% of admitted students in 2018. Furthermore, in the second period, there is a stronger correlation between an increase in racial diversity and test-score requirements, implying that quotas had a greater impact on more selective majors.

Figure 4: Increase in Racial Diversity and Test Scores by Major



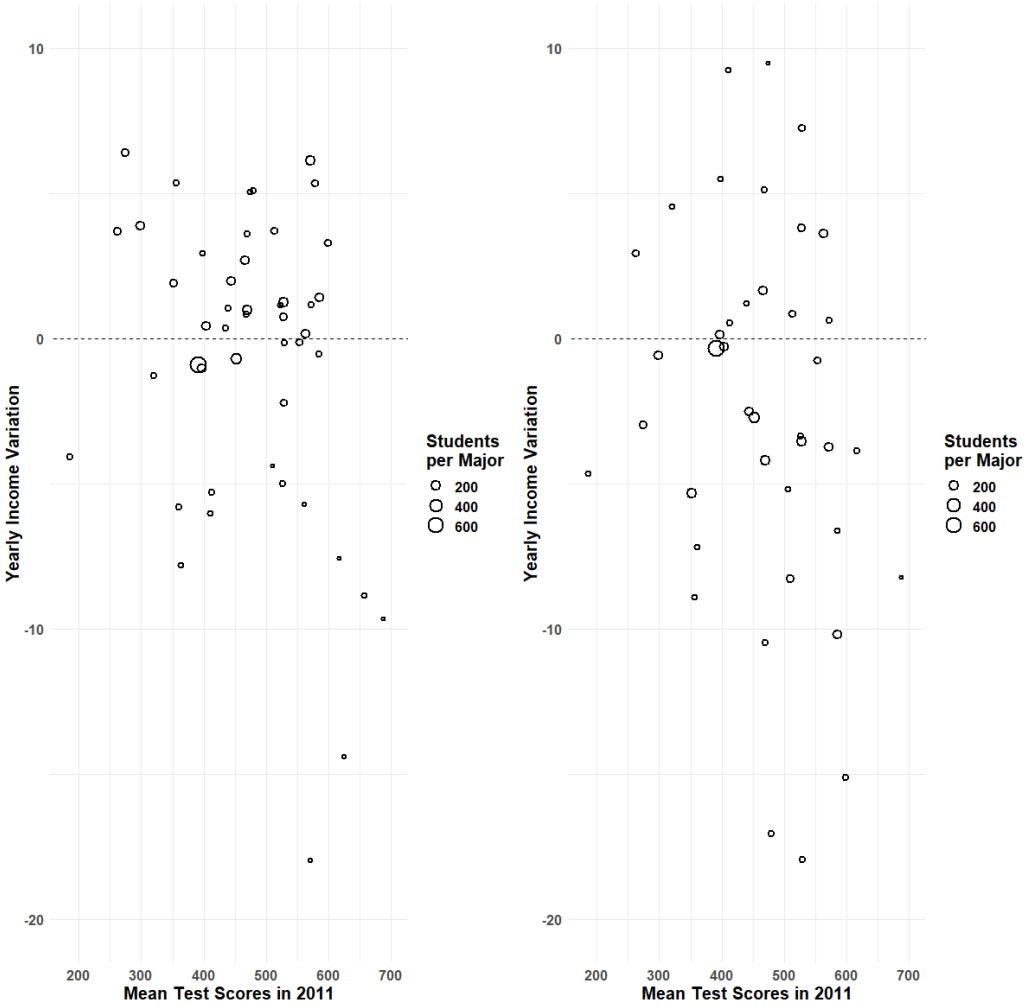
(a) First Period (2011-2015) (b) Second Period (2015-2018)

Notes: The first period Refers to the years in which only the Inclusp Bonus was active. The Second Period refers to when both the Inclusp system and reserved slots were active. Data on racial identification is limited to valid answers on pre-enrollment student questionnaires, meaning there is data available for around 70% of the entire 2011-2018 sample of students in the main USP Campus.

Similarly to the analysis on racial composition, Figure 5 shows the same

course-specific plots examining the mean yearly variation in household income in both periods. Both periods show a reduction of each major's average income levels, which decreased by 6.7% overall in the first period and 8.2% in the second. As in the case with race, however, this compensating effect is larger for the most selective majors in the second period (Figure 5b) when reserved quotas are in effect than when the bonus system was active (Figure 5a).

Figure 5: Yearly Income Variation and Test Scores by Major



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2.2 Student Aid Policy and Eligibility

In order to estimate specifically the effect of the stipend on persistence, we matched a unique student identifier results in the universe of 1349 first-year undergraduate students entering courses offered in the main campus of the University of São Paulo in 2018 who requested student assistance. Definite answers for the admissions test questionnaires are not mandatory (ie. the applicant can reply "prefer not to answer"), so information on race and household income is only available for about 80% and 90% of the sample respectively. The cutoff in the vulnerability score for i) Monthly Stipend (P1-S) and ii) Student Housing (P1-H) is defined as the score assigned to the lowest scored candidate who received the benefit eligible to that group. By that definition, the cutoff for P1-S was 95.01 and 129.05 for P1-H.

Since many of the students eligible for housing (P1-H) had chosen to apply for a stipend instead, there is a much smaller discontinuity in the probability of treatment (housing slots) between the groups P1-H and P1-S than that of the treatment received from the cutoff between P2 and P1-S (stipend). Therefore, we will exclude group P1-H from our sample - focusing solely on the effect of the stipend.

The final dataset has 970 students, of which 628 are eligible and 342 are not eligible for the monthly stipend. Figure 1 shows a histogram of the vulnerability scores, with the dashed line indicating the cutoff point of 95. Figure 2 shows that, while there are no applicants with a vulnerability score below 95 with the stipend, around 55% of student immediately above cutoff begin to receive it, which increases to up to around 75% for those with a greater vulnerability scores.

Table 2 shows the cutoff value and the proportion of applicants who were eligible for and received the stipend. Additionally, using the questionnaires, the table shows the how the group that is eligible has a lower household income, is more likely to self-report as black, brown or indigenous and has a higher proportion of males than the non eligible group. However, both groups have very similar admission test scores. In terms of student outcomes, the eligible group has lower persistence - defined as remaining enrolled in the same course they were admitted in and reach the end of year n - and also a higher incidence of dropping out.

This data was received in 2023, meaning the students who had not graduated or

dropped out were enrolled in their sixth year. We do not attempt to estimate graduation or timely graduation rates, since undergraduate courses of the university of São Paulo i) vary from four to five years long in ideal duration, even within the same degree, depending on whether they taken at night time or day time ii) there is a delay of around a semester between attaining the credits necessary for degree completion and graduation being registered in the Jupiterweb System. This additionally means that our estimate for dropping out does not capture students who would only terminate their course in their sixth or above years. However, there is ample evidence that the majority of attrition occurs before this time (Klitzke and Carvalhaes 2023).

Table 2: Summary Statistics

Variable	**Value**
Number of Students	970
Cutoff Score (Stipend)	95.01
Students Eligible for Stipends (%)	64.7
Stipends Awarded	427
Students with Stipends (%)	44.0

	Not Eligible			**Eligible**		
Personal Characteristics	Mean	Std. Error	N	Mean	Std. Error	N
Vulnerability Score	39	68	342	114	9.1	628
Female (%)	57	50	342	43	50	628
Black, Brown or Indigenous (%)	23	42	274	46	50	499
Household Income (R$)	11,568	7,976	313	4,993	3,493	551

	Not Eligible			**Eligible**		
Admission Characteristics	Mean	Std. Error	N	Mean	Std. Error	N
Admission Test Scores	595	107	342	602	111	628
Any Reserved Slot (%)	17.8	38.3	342	42.2	49.4	628
Public-School Slot (%)	11.7	32.2	342	18	38.4	628
Racial Slot (%)	6.14	24	342	24.2	42.9	628

	Not Eligible			**Eligible**		
Student Outcomes (%)	Mean	Std. Error	N	Mean	Std. Error	N
Persistence (2nd Year)	93	26	342	90	30	628
Persistence (3rd Year)	89	31	342	85	36	628
Persistence (4th Year)	78	41	342	76	42	628
Dropping Out	18	38	342	25	43	628

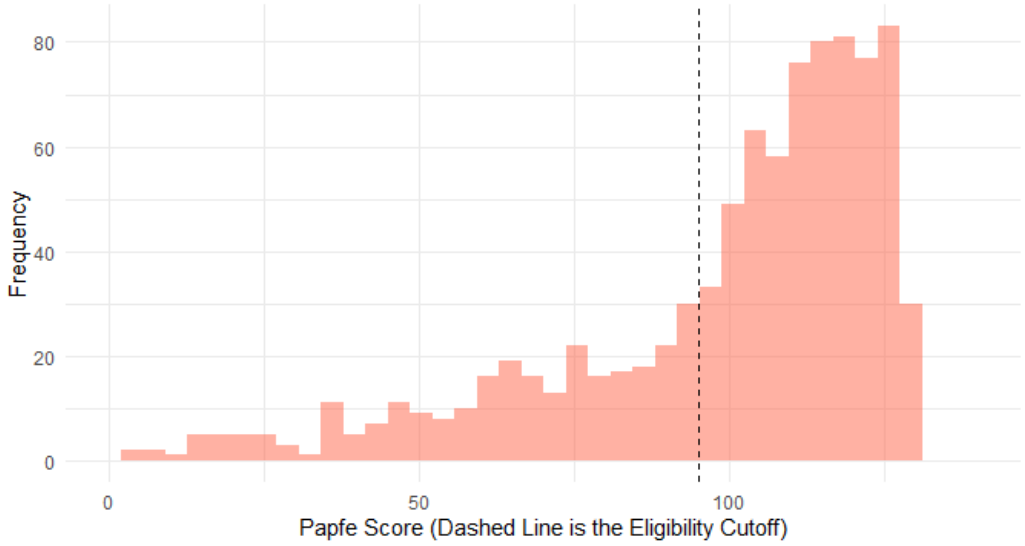

Figure 6: Distribution of Vulnerability Scores and Eligibility Cutoff

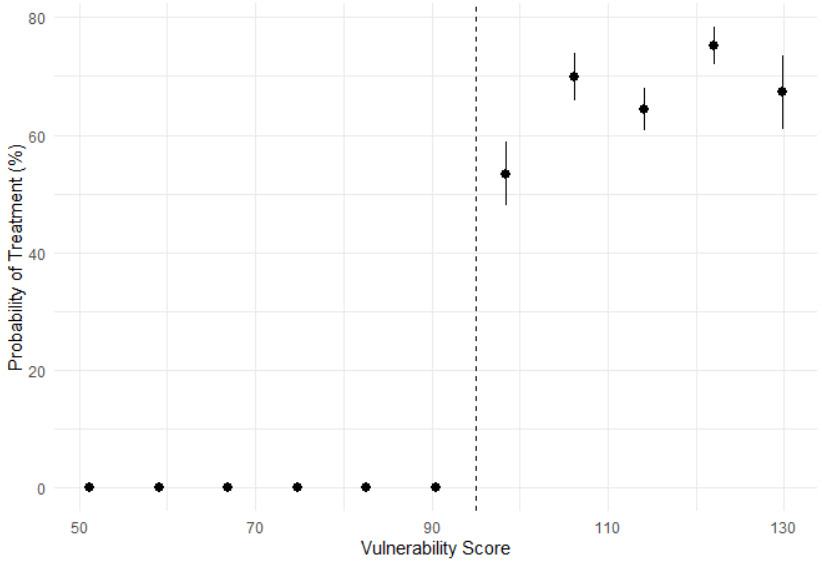

Figure 7: Vulnerability Scores and Probability of Treatment

3 Empirical Strategy

A popular procedure to estimate the effect a policy whose enactment is determined by a cut off a certain "forcing" variable - such as income levels or electoral victory margins - is through a Regression Discontinuity (RD). The central idea of RD is to estimate the difference in outcomes between those who narrowly did and did not receive the policy, using the observations near the threshold of this forcing variable whose value determines eligibility, rather than to attempt to compute the treatment effect for the entire sample. Assuming the forcing variable can't be manipulated and that those around the cutoff only differ in receiving the policy, the causal effect can be inferred based on the disparity between these two groups.

The validity of RD requires absence of a systematic relationship between unit characteristics above and below the cutoff. Formally, this is the equal to the assumption that the covariates x are a continuous function at the cutoff c in the forcing variable z. Therefore, for observations are close to the cutoff, meaning that for z_i close to c, the treatment assignment is effectively randomized. This implies the that, in the limit approaching the cutoff, the discontinuity in outcomes y is equal to the treatment effect:

$$\beta = \lim_{z \to c^-} \frac{\partial E(y \mid z)}{\partial z} - \lim_{z \to c^+} \frac{\partial E(y \mid z)}{\partial z} \tag{1}$$

Where β is the estimated Local Average Treatment Effect (LATE), while $E(y \mid z)$ is the conditional expectation of y given z. Another assumption is that there is common support on both sides of the cutoff, meaning that there are observations both below and above the cutoff point. Units cannot perfectly predict their treatment status and there is no systematic sorting around the cutoff point. Lastly, the density functions of covariates and the propensity score are continuous and have finite moments. For the sharp case, the probability of treatment of a unit above or below the cutoff is equal to one, while fuzzy designs only necessitate this probability to be discontinuous.

A way to investigate the absence of sorting is to examine the balance of covariates across the threshold. Assuming that there is non-random sorting, there should be a discontinuity in prevalence of student characteristics (ie. race, gender, test scores) in either side of the cutoff. Using data from pre-enrollment ques-

tionnaires answered before the admissions test, Table 3 shows that RD estimates fail to reject the null hypothesis of no discontinuity in admission scores, gender, household income and Black, Brown or Indigenous (BBI) self-identification in our sample. Figure 3 visualizes these results, showing the mean with error bands for each covariate in terms of vulnerability score bins around the cutoff. The average self-reported pre-enrollment household income (in thousands) in each bin is strictly decreasing with higher vulnerability scores. The incidence of black, brown or indigenous race - which is greater for poorer households in the general Brazilian population - also generally increases with vulnerability score of applicants. These are important indicators that the vulnerability score is in fact an accurate ordinal ranking of the students socioeconomic condition, as there is no such clear linear relationship with admission scores.

Table 3: Balance of Applicant's Pre-Admission Covariate Characteristics around the Threshold

Variable	Female	BBI	Test Scores	Income
Robust Estimate	-0.066	-0.154	-57.72	-1.298
	(0.120)	(0.139)	(43.79)	(1.005)
Obs Below Cutoff	341	274	341	303
Obs Above Cutoff	629	499	629	520
Effective Obs. Below	236	168	230	184
Effective Obs. Above	179	119	73	106

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Note: Two Optimal bandwidths above and below cutoff following Calonico et al. (2014) were chosen to minimize the mean squared error of the local first-order polynomial RD point estimator, using triangular kernels. Robust Standard Errors are in parenthesis. Income refers to Household Income. The question on the survey on income and racial identification was answered by 89% and 79% of students, respectively. There was data on gender and test scores for the entire sample. Estimates were obtained using the subsample for which there was available data. Income refers to total monthly household income in thousands. The original questionnaire asked the applicant to answer their total monthly household income in multiples of the 2017 minimum wage. We assume that each household income is exactly in the middle of each range, then convert its value to 2023 R$.

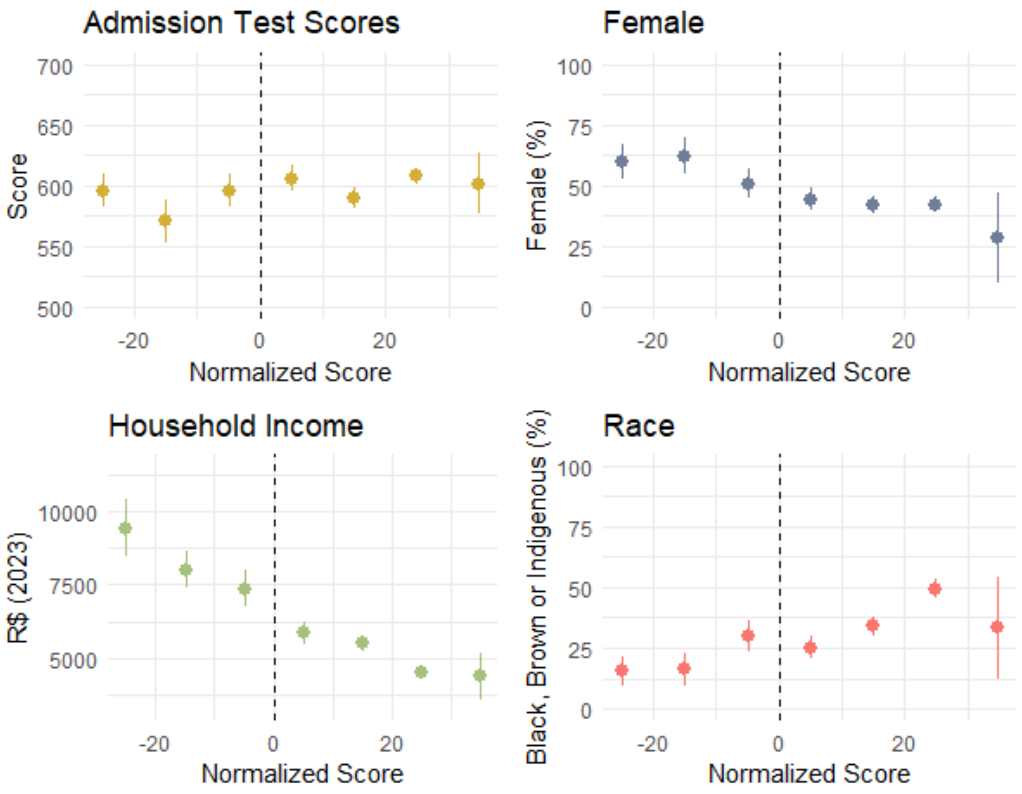

Figure 8: Balance of Covariates Across the Thresshold

In this study, the primary objective is to estimate the impact of receiving a stipend on students' academic outcomes. To achieve this, we utilize a Fuzzy 2SLS (Two-Stage Least Squares) estimation approach, leveraging a vulnerability score as an instrumental variable to identify the effect of stipend receipt on student success. In the first stage, we analyze the impact of the threshold for eligibility in vulnerability score, acting as an instrument, on the likelihood of receiving a stipend. The second stage examines the effect of the stipend, as predicted from the first stage, on the outcome variable. The equations are as follows:

First Stage

$$\begin{aligned} Stip_i = f(Score_i - 95) + \alpha_1 Elig_i + \\ \alpha_2 Elig_i \text{X} (Score_i - 95) + \alpha_3 Area_i + \epsilon_i \end{aligned} \tag{2}$$

Second Stage

$$\begin{aligned} Y_i = f(Score_i - 95) + \beta_1 (\widehat{Stip_i}) + \\ \beta_2 Elig_i \text{X} (Score_i - 95) + \beta_3 Area_i + \mu_i \end{aligned} \tag{3}$$

In the regression, $Score_i$ denotes the vulnerability score for student i and $Stip_i$ is a dummy variable indicating the receipt of a stipend in the first year. $Elig_i$ indicates eligibility, $Area_i$ are fixed-effects for the course (major) the student enrolled in and Y_i represents the academic outcome.

Following the methodology set out in Calonico et al. (2014), we estimate this equation with bias-corrected non parametric confidence intervals, for each side of the cutoff, chosen to minimize the mean squared error of the local polynomial $f(\cdot)$. A triangular kernel function, denoted as $K(\cdot)$, assigns weights to observations based on their proximity to the cutoff point. It is defined as:

$$K(u) = \begin{cases} 1 - |u|/h & \text{if } |u| \leq h \\ 0 & \text{if } |u| > h \end{cases}$$

where u represents the distance of an observation from the cutoff point, and h is the bandwidth, representing the range within which observations are included in the estimation. For all outcome variables, we include results with nearest-neighbour robust standard errors.

We do not control for whether eligible students renewed the benefit in the following year, nor if non-eligible students became eligible in the following years. Therefore, our results are only measuring the effect of first-year benefit on academic performance in the following semesters.

A key requirement for accurately assessing the estimators found in the second stage as the causal effect of stipend receipt on student academic performance is the exclusion restriction of the instrumental variable. In our case, this implies that the vulnerability score affects student academic performance only through its impact on the probability of receiving the stipend, with no direct effect. Since students literally do not know what their vulnerability score is, but rather which benefits they are eligible for, this condition is easily satisfied. Another main condition is that of the instrument's relevance, meaning that there is a strong correlation between it and the treatment. This latter requirement can be demonstrated empirically by the significance of the first stage coefficient estimate.

4 Results

This section outlines the primary findings of the paper, which focus on evaluating the impact of the stipend on various student outcomes related to persistence. The first outcome assessed is continued enrollment, which is defined as students not dropping out of their courses, changing majors, or having their enrollment terminated by the university for reasons detailed in section II.

To measure persistence to different years, we employ dummy variables to indicate continual enrollment after entering in 2018, extending to year t+N. In other words, these dummies signify students who remained enrolled at least until a specific year without dropping out (for instance, t+1 refers to students who stayed enrolled until at least the last semester of 2019). Conversely, "Drop-Out" categorizes any student who was not enrolled in their major nor graduate by the end of their fifth year, whether by their decision to leave the course or due to administrative reasons.

Moving on to the main results, we first report the coefficients of the first-stage estimate. Not all majors have variability in outcome variables (ie. some courses have full cohort persistence), so there are different estimates for the optimal bandwidth depending whether Fixed-Effects are added (Table 4). The first-stage estimates are significant at the 1% level for all outcome variables, indicating that reaching eligibility induces around 59-67% of students to receive the stipend. Figure 4 shows this discontinuity, for the case of the regression on the outcome of dropping-out.

Table 4: Estimate of the Effect of the Eligibility on Receiving the Stipend

	Enrolled (t + 1)	Enrolled (t + 2)	Enrolled (t + 3)	Drop-Out
A: No Controls				
First-Stage Coefficient	0.614***	0.589***	0.674***	0.602***
	(0.105)	(0.101)	(0.114)	(0.103)
Obs. Below Cutoff	341	341	341	341
Obs. Above Cutoff	629	629	629	629
Effect. Obs Below	238	249	249	238
Effect. Obs Above	122	149	94	142
B: With Majors FE				
First-Stage Coefficient	0.656***	0.623***	0.651***	0.610***
	(0.106)	(0.103)	(0.106)	(0.103)
Obs. Below Cutoff	341	341	341	341
Obs. Above Cutoff	629	629	629	629
Effect. Obs Below	234	249	261	226
Effect. Obs Above	83	97	77	110

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Note: All Estimates include Robust Standart Errors in Parenthesis. Two Optimal bandwidths above and below cutoff following Calonico et al. (2014) were chosen to minimize the mean squared error of the local first-order polynomial RD point estimator, using triangular kernels. Observations in majors in which there was no variation in the outcome variable were dropped.

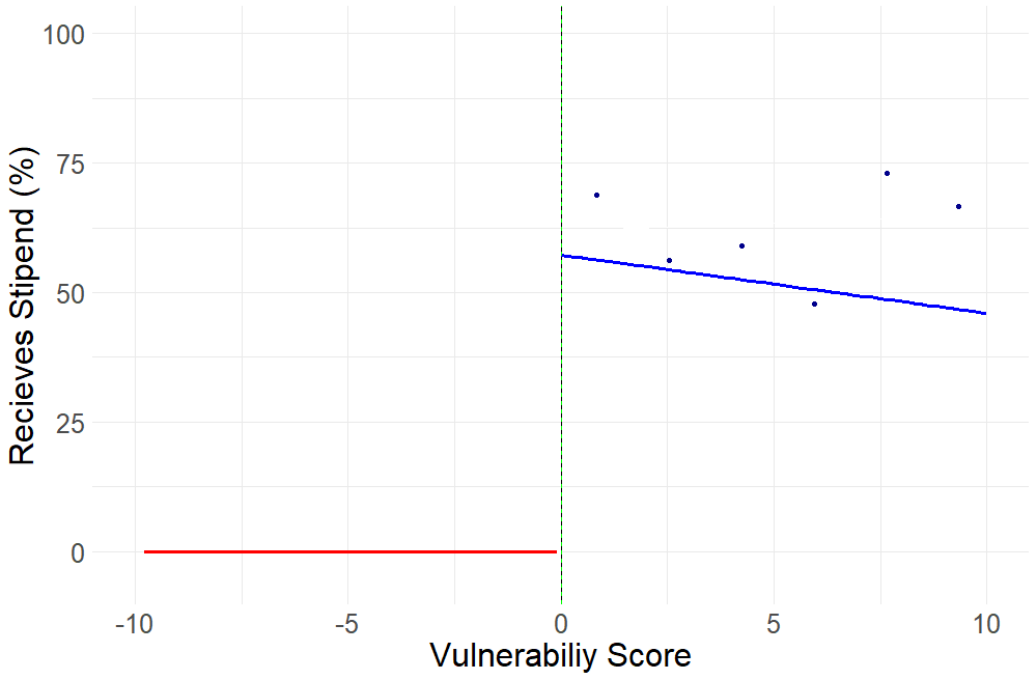

Figure 9: Discontinuity in Treatment near the Cutoff in Vulnerability Scores

In the second-stage, RD estimates in Table 5 reveal that students who received the benefit were 56% more likely to remain enrolled to the end of their forth year than their classmates who did not classify for the benefit, at the 1% significance level. In terms of dropping out, the treated student was also 33% less likely to have dropped out of the course before beginning their sixth year, at the 5% significance level.

Table 5: Estimate of the Effect of the Stipend on Student Persistence

	Enrolled (t + 1)	Enrolled (t + 2)	Enrolled (t + 3)	Drop-Out
A: No Controls				
Second-Stage Estimate	-0.024	0.009	0.246	-0.005
	(0.116)	(0.139)	(0.168)	(0.167)
With Robust Std. Errors	-0.024	0.009	0.246	-0.005
	(0.135)	(0.164)	(0.194)	(0.195)
B: With Majors FE				
Second-Stage Estimate	0.263***	0.239**	0.563***	-0.333**
	(0.076)	(0.108)	(0.125)	(0.140)
With Robust Std. Errors	0.263***	0.239*	0.563***	-0.333**
	(0.087)	(0.126)	(0.144)	(0.160)

* p $<$ 0.1, ** p $<$ 0.05, *** p $<$ 0.01

Note: Sample size is the same as reported in Table 4. Two Optimal bandwidths above and below cutoff following Calonico et al. (2014) were chosen to minimize the mean squared error of the local first-order polynomial RD point estimator, using triangular kernels. In the estimation with controls, observations of students in majors in which there was no variation in the outcome variable were dropped.

To test for the robustness of these results, we include in the appendix tests for sensibility to different bandwidths and selection criteria, as well as test for placebo cutoff values for stipend eligibility. We also employ manipulation tests to determine if there is evidence of manipulation of the running variable near the cutoff. These checks confirm the validity of our initial findings.

To present a visualization of the effect of the eligibility on drop-out rates, we estimate the mean and 95% confidence intervals in the bins of applicants in either side of the cutoff in Figure 5. Figure 6 shows the effect on Fourth-year Persistence. Figure 7 and Figure 8 show the contrast in drop-out and persistence rates respectively, but only for students in the major of Languages/Literature, which has the highest number of applicants of our sample (N = 238). As expected from the previous results, the effect of eligibility on the outcomes variables is only visible for the case comparing outcomes within the same major. Despite the small sample size, the average outcome for the bins for language students in either side of the cutoff are discontinuous in the expected direction, with no overlap in the confidence intervals.

Figure 10: Vulnerability Score and Fourth-Year Persistence (All Students)

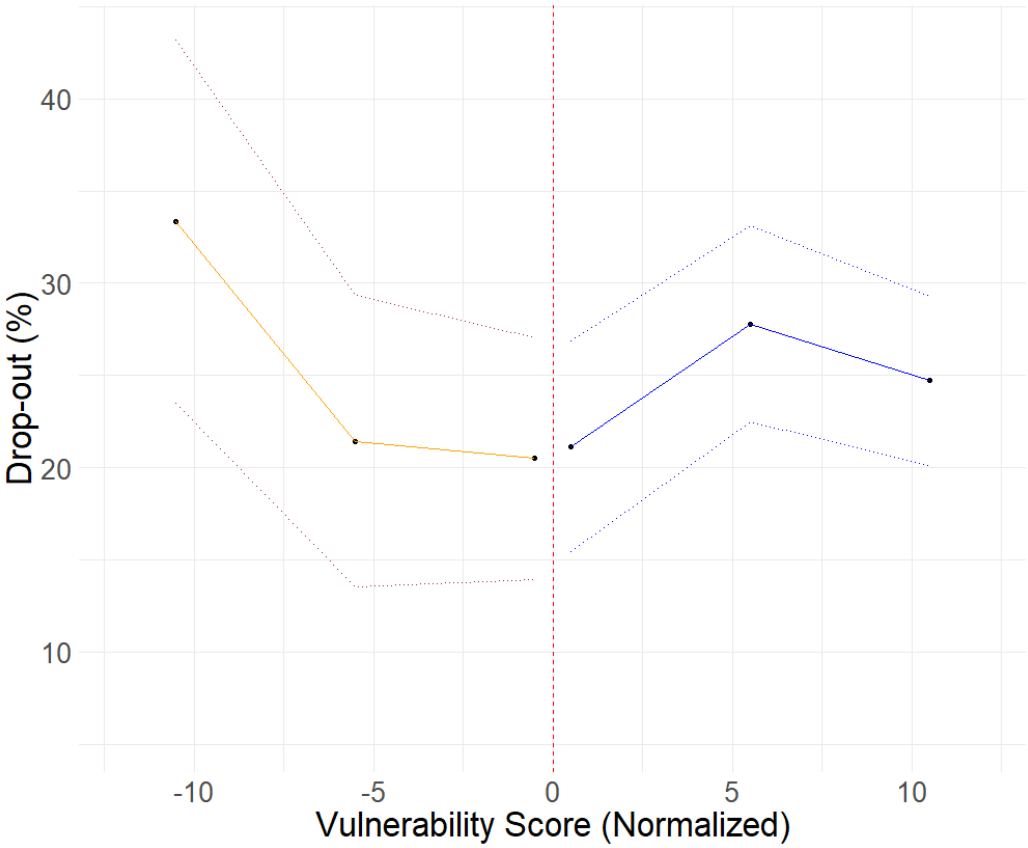

Figure 11: Vulnerability Score and Drop-out Rates (All Students)

Figure 12: Vulnerability Score and Drop-out Rates (Language Students)

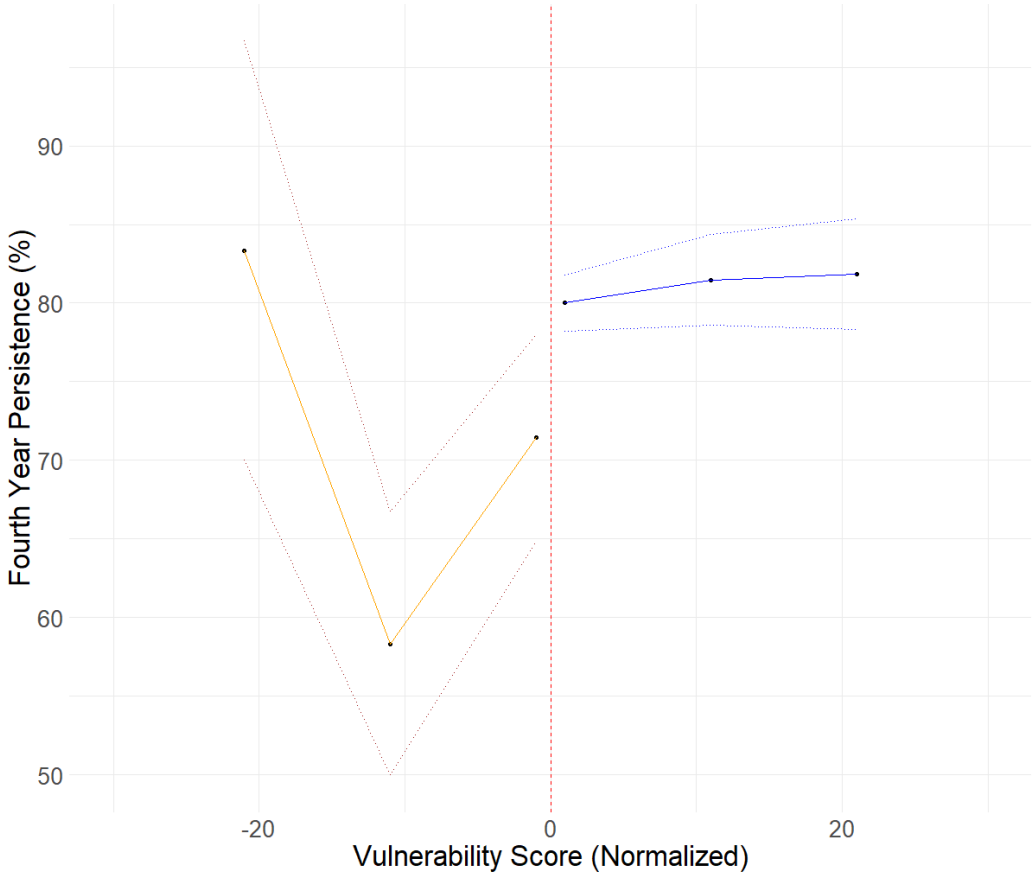

Figure 13: Vulnerability Score and Fourth Year Persistence (Language Students)

The stipend's effects are only significant when controlling for majors fixed-effects, which indicates that the relationship between major choice and the decision to apply for aid leads to a bias towards zero for the coefficient. By including majors fixed-effects in both the first and second stage of the 2SLS estimation, the predicted values reflect this heterogeneity.

Choice of major to the university of São Paulo is made before taking the admissions tests, unlike university systems in most advanced economies. This choice reflects students' demographic characteristics, ingrained social norms and unobserved personal preferences (Lemos 2019, Bustelo et al. 2021) and can be a driver of inter-generational immobility (Duryea et al. 2019). In most previous studies on the effects of student aid in developed economies, major choice was a post-enrollment outcome and therefore not included as a control variable. In our case, however, it is possible for there to be a correlation between majors-specific drop-out rates and propensity to apply for aid, resulting in a coefficient that is biased compared to the true effect of the stipend.

To examine this possibility, we compiled major-specific propensity of application and drop-out rates for all students enrolling in each of the majors (N = 71) in 2018. Table 5 shows that there is a negative correlation between the percentage of students in each major who applied to aid and the dependent variable of drop-out rates. Figure 8 illustrates these results. Students more likely to apply to aid were also more likely to enroll in courses with a lower drop-out incidence. Controlling for the major's demographic composition, mean test scores and mean household income does not change this association, which remains significant.

Table 6: Correlation of Major-Specific Student Composition and Incidence of Aid Application and Drop-Out Rates

	(1)	(2)	(3)	(4)
(Intercept)	35.092***	127.353***	136.040***	129.962***
	(3.727)	(17.840)	(14.657)	(15.415)
Students Applied for Aid (%)	−0.261***	−0.330***	−0.187**	−0.195**
	(0.081)	(0.070)	(0.093)	(0.092)
Mean Test Score		−0.001***	−0.002***	−0.002***
		(0.000)	(0.000)	(0.000)
Household Income			1.518	1.323
			(1.103)	(1.098)
BBI (%)				0.257**
				(0.115)
Female (%)				−0.065
				(0.075)
R^2	0.156	0.273	0.322	0.445
R^2 Adj.	0.136	0.238	0.252	0.372

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

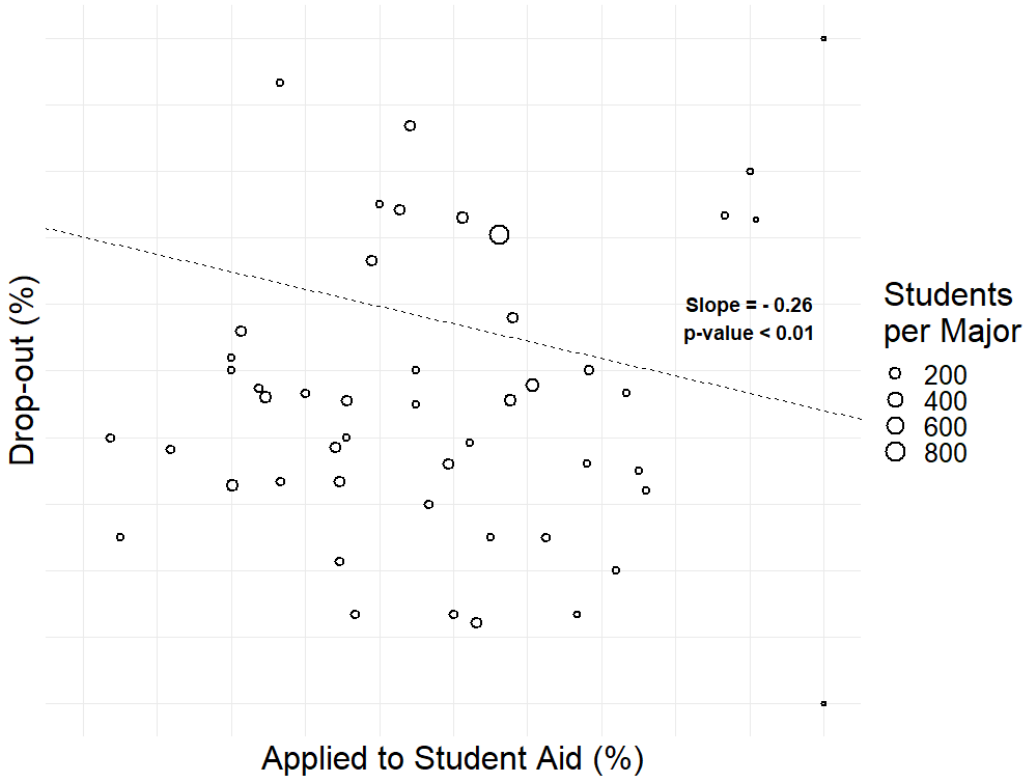

Figure 14: Incidence of Application to Aid and Drop-Out Rates By Major

Note: Size of each Point represents the number of students enrolling in each Major in 2018. Value of the Slope coefficient is identical to that of column (1) of table 5.

5 Conclusion

Our paper shows student assistance in the form of conditional cash transfers contributes to the persistence of historically underrepresented groups in the context of elite higher education. We are able to employ a regression discontinuity to robustly estimate the effect of a cash stipend only to actively enrolled students, whereas previous research has focused mainly on programs in which eligibility leads to marginal students enrolling due to the benefit. This means our results are not biased by the fact that marginal students may differ from infra-marginal

students in ways that could influence the estimates.

As with any RD based estimates, a few caveats are in order. Although the results presented have strong internal validity, it is necessary to stress that they are not necessarily applicable to other countries and higher learning institutions. Furthermore, our coefficients are a measure of the Local Average Treatment Effect (LATE) of the students near the eligibility cutoff, rather than measuring the impact of the stipend for the entire sample.

Nevertheless, we believe our results provide two principal implications for the importance of needs-based assistance programs to low-income applicants. First, we believe this paper sheds light on the importance of considering major choice in theoretical and empirical discussion of student aid policy, specially in higher learning contexts in which this choice is a pre-enrollement variable.

Second is that the results indicate that the effect of student aid differs based on the opportunity costs of alternative forms of higher learning and the college wage premium, both of which are high in Brazil and the USP in particular. The meta-analysis on Effects of Grant Aid on Student Persistence by Nguyen et al. (2019) reports that student aid have a mean effect on year-to-year persistence (i.e., first to second year or first to fourth) of around 2 percentage points, although the author stress that this value aggregates all such outcomes in the literature regardless of length of persistence. The most comparable study in terms of methodology, Fack and Grenet (2015), found that a 1500 Euro yearly stipend increases persistence to the end of the second year for undergraduate students by 4.4% and found positive but not statistically significant effects for the third or fourth year. By contrast, our estimates show a 26% effect for finishing the second year and a 56% effect in reaching the fourth year - with both outcomes being significant at the 1% level, despite the relatively small sample. Even when adjusting for the different cash values of each program, there is still a large difference in the effect of the benefit.[4]

Since current Brazilian law mandates a certain percentage of slots in public universities for very low-income students, persistence policies are crucial not only

[4]Fack and Grenet (2015) calculated that the *Bourses sur Criteres Sociaux* benefit covered around 25% of living expenses for an average French student. Although there is no data on this subject available, we estimate that the R$500 benefit in 2018 could cover anywhere from 25-60% of the living costs for a student near the main Butantã Campus.

in the view of equity concerns, but also to prevent the wasting of public resources due to the attrition of students who, if not for financial difficulties, could otherwise complete their degree. While not all (and perhaps not the majority) of dropping-out behaviour among low-income students can be attributed to financial pressures, there is certainly a financial component which merits special consideration by policy-makers and university managers.

In order to determine the cost-effectiveness of persistence programs, it is necessary to weight the present cost of an university education and the aid benefit against the life-time private and social return of tertiary education induced by the program. Fack and Grenet (2015) have shown, using data on the returns of tertiary education and taking into account the costs of providing a public college degree in France that the annual €1500 grant is cost-effective. Bielschowsky and Amaral (2022) estimates that the yearly costs for an undergraduate education for state-run research universities in São Paulo in 2018, including the USP but also UNICAMP and UNESP, is equal to around R$18,500 when considering the portion of the budget allotted to teaching rather than to research or extracurricular activities. Considering a student with a stipend for all years while enrolled at 2018 values, the benefit would add about 25% relative to the baseline student cost.

Our data does not allow us to identify the effect of the stipend on study completion, which would be necessary to estimate its benefits - whether private (student's wage premium) or social (worker's increased contribution in taxes). Considering the large private and social returns to a degree in Brazil, the results indicate the stipend could also be cost effective, but follow up studies on the graduate and post-graduate outcome of the cohort studied would ultimately be necessary to arrive at any definitive answer.

6 Appendix

This section contains robustness tests for the results. The first is a placebo test in which we choose a different cutoff value for the vulnerability score in the first-stage estimate (Table 6). A difference in the cutoff, such as changing the value by five (to 90 or 100), leads to null estimated affects for the benefit. This means that

students very near the (false) cutoff show no significant differences in outcomes, which supports our initial findings.

Table 7: Placebo Test of the Effect of the Stipend on Student Persistence

Cutoff	Enrolled (t + 1)	Enrolled (t + 2)	Enrolled (t + 3)	Drop-Out
90	−0.109	−0.004	0.070	−0.231
	(0.570)	(0.610)	(0.569)	(0.533)
95	0.263***	0.239*	0.563***	−0.333**
	(0.087)	(0.126)	(0.144)	(0.160)
100	−0.142	0.034	−0.459	2.454
	(2.304)	(2.260)	(4.910)	(2.814)

* p < 0.1, ** p < 0.05, *** p < 0.01

Note: All estimates include Majors Fixed-Effects. Two Optimal bandwidths above and below cutoff following Calonico et al. (2014) were chosen to minimize the mean squared error of the local first-order polynomial RD point estimator, using triangular kernels. The table presents the second-stage estimate, with robust standart errors in parenthesis. The row with cutoff of 95 is identical to that of our main results (second row of table 6B).

In order to determine if there is evidence of manipulation of the sorting variable, we employ the local polynomial density discontinuity test developed by Cattaneo et al. (2020). A normalized vulnerability score variable is created by subtracting from the vulnerability score the cutoff for eligibility, so that the new cutoff point is equal to zero. Table 7 shows the test fails to reject the null hypothesis of no manipulation around zero in this forcing variable, while Figure 9 displays these results showing confidence intervals.

We now proceed to test the sensibility of the estimates for different bandwidth selection criteria. In the baseline estimates bandwidths for either side of the cutoff chosen to minimize the Mean Squared Error (MSE) of the local first-order polynomial RD point estimator. Table 8 shows the results when we reduce or increase those bandwidths by 50%. We also include shows the results when employing an alternative bandwidth selector that minimises the Coverage Error Rate (CER) rather than the MSE. All these alternative bandwidth specification produce estimates of the effect of the stipend on fourth year persistence and dropping-out

Table 8: Manipulation testing using local polynomial density estimation

	Manipulation Test	
	Left of c	Right of c
Number of obs	341	629
Eff. Number of obs	183	579
Order est. (p)	2	2
Order bias (q)	3	3
BW est. (h)	34.516	31.356
	T	P > | T|
Robust	-0.1211	0.9036

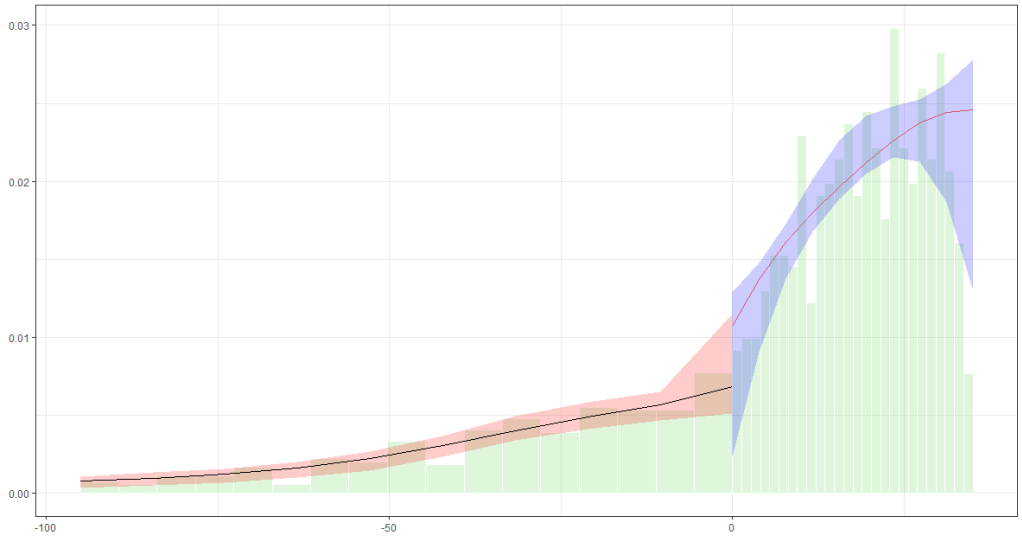

Figure 15: Manipulation Testing using Local Polynomial Density Estimation

which are similar in magnitude to the baseline case.

Table 9: Robustness Test for Variation in Bandwidth Relative to Baseline

	Enrolled (t + 1)	Enrolled (t + 2)	Enrolled (t + 3)	Drop-Out
A: Optimal Bandwidth				
Second-Stage Estimate	0.263***	0.239**	0.563***	−0.333**
	(0.076)	(0.108)	(0.125)	(0.140)
With Robust Std. Errors	0.263***	0.239*	0.563***	−0.333**
	(0.087)	(0.126)	(0.144)	(0.160)
B: 50% Smaller				
Second-Stage Estimate	0.350***	0.331***	0.548***	−0.433***
	(0.075)	(0.109)	(0.123)	(0.134)
With Robust Std. Errors	0.350***	0.331**	0.548***	−0.433**
	(0.098)	(0.165)	(0.177)	(0.183)
C: 50% Larger				
Second-Stage Estimate	0.172***	0.224***	0.528***	−0.287***
	(0.065)	(0.079)	(0.095)	(0.103)
With Robust Std. Errors	0.172**	0.224*	0.528***	−0.287*
	(0.084)	(0.115)	(0.136)	(0.148)
D: Using CER Criteria				
Second-Stage Estimate	0.308***	0.332***	0.534***	−0.310**
	(0.077)	(0.112)	(0.132)	(0.140)
With Robust Std. Errors	0.308***	0.332***	0.534***	−0.310**
	(0.082)	(0.120)	(0.139)	(0.151)

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Note: All estimates include Majors Fixed-Effects. The panel A is identical to that of our main results in Panel 6B.

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