The Impact of Subsidies for Higher Education: Evidence from Brazil

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Job Market Paper

This Version: December 20, 2020

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Abstract

Investment in human capital and skill formation are a crucial feature of any effective development strategy, but much remains unknown on the consequences of policies designed to increase attainment and reduce inequality in access to higher education. We exploit a discontinuity in eligibility for subsidies for private higher education in Brazil to investigate the causal impact of financial aid on the human capital investment decisions of students in the lower end of the ability distribution. We show that these students increase their likelihood of enrolling and persisting in higher education in response to financial aid eligibility. Exploring how students react when they are given the chance to choose between public tuition-free institutions and subsidized access to private higher education, we show that students eligible for aid are less likely to enroll in public institutions, with no significant impact on program quality. Finally, we evaluate distributional consequences and show that the impact is stronger for students in the higher end of the income distribution of potential beneficiaries.

[*]Isabela Duarte thanks Juliano Assunção for his continued guidance and support, and Claudio Ferraz, Michela Carlana, Cecília Machado, Gustavo Gonzaga and seminar participants at PUC-Rio for helpful comments.

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1 Introduction

Investment in human capital and skill formation are a crucial feature of any effective development strategy, as human capital accumulation is related to differences in individual income both between and within countries (Hanushek and Woessmann (2008), Acemoglu and Dell (2010), Gennaioli et al. (2013)). Across the world, governments adopt different strategies to subsidize—fully or partially—enrollment in higher education with the goal of promoting the productivity gains and prosperity often associated with increased educational attainment. Much remains unknown on the impact of these policies and the incentives they create. In this paper, we exploit a discontinuity in eligibility for financial aid for private higher education in Brazil to investigate: (i) if students in the lower end of the ability distribution change their behavior in response to a policy designed to subsidize access to private higher education, (ii) how students react when they are given the chance to choose between public tuition-free institutions and subsidized access to private higher education, and (iii) if the subsidy policy has a differential impact on students with different backgrounds.

Estimating the causal impact of subsidy policies for higher education is challenging. Unobserved factors determine students' participation in such policies and the human capital investment decisions they make. We handle this identification challenge exploring a discontinuity in eligibility for financial aid for private higher education in Brazil. The country's federal government subsidize access to private higher education through two different programs: a scholarship program—PROUNI—and a subsidized credit program—FIES. Eligibility for PROUNI and FIES is restricted to students who meet a minimum academic performance requirement. Specifically, students are required to obtain the minimum grade of 450 in the national standardized evaluation for high school students (ENEM) to be considered eligible for subsidies. This minimum performance requirement is set at the low end of the national ability distribution—it represents the percentile 23 of the distribution of ENEM grade. Thus, lower ability students are the ones most affected by the eligibility rule.

We exploit the discontinuity in access to subsidies to empirically evaluate how eligibility for financial aid impact the human capital investment decisions of lower ability individuals. In our analysis, we make use of a detailed data set that links students' performance on the national standardized evaluation to their decision to enroll or not in any higher education institution in the country. The identifying assumption is that students who obtain a grade just above and just below the eligibility threshold are comparable in

all relevant factors except eligibility for financial aid. To obtain an estimate of the causal impact of eligibility for financial aid on the decisions of low ability individuals, we compare students on both sides of the eligibility threshold through a Regression Discontinuity Design (RDD).

We have five main sets of results. First, We evaluate the impact of eligibility on students' decision to enroll in higher education and to persist up to three years after initial enrollment. We show that eligibility for financial aid increases students' likelihood of enrolling in higher education by approximately 10%. It also increases by 10% the likelihood of persisting one, two and three years after initial enrollment.

Second, we evaluate how eligibility for subsidies for private higher education impacts students' decision to enroll in public tuition-free higher education. Several countries are facing growing demand for tuition-free alternatives to higher education (Espinoza and Urzúa (2015), Murphy et al. (2019), Nguyen (2019)). Much remains unknown on how tuition-free publicly funded institutions affect students' decisions and the dynamics of the higher education market. Peltzman (1973) argues that in-kind subsidies—such as free-tuition public higher education—can distort students' decision, crowding out productive investment in private education. In our setting, some of the students who become eligible for financial aid for private education are also likely to qualify for public tuition-free education. To evaluate if students would change their educational choices if they were given the chance to choose how to apply subsidies between public and private schools, we estimate the impact of becoming eligible for subsidies for private education on students' decision to enroll in public higher education. We find that eligibility for subsidies decreases the likelihood of enrolling in public higher education, a finding consistent with Peltzman's model.

Third, we evaluate the distributional consequences of the subsidy policy and how they are related to the rules determining subsidy allocation. Our results show that the eligibility effect is increasing with family income up to the income level in which students are restricted from applying to financial aid. This result is consistent with the rules for subsidy allocation under both the credit—FIES—and the scholarship program—PROUNI. In both programs, students apply for aid at the major-institution level and subsidies are distributed, in case of excess demand, to students with the highest grades in the national evaluation of high schools students (ENEM). If income and academic ability are positively correlated—as it is the case in our setting—students in the higher end of the income distribution of potential beneficiaries are more likely to obtain subsidies. Our results highlight the importance of policy design and suggest that policies intended to benefit lower

income individuals should explicitly consider income for subsidy allocation.

Fourth, we focus on estimating possible heterogeneities by race. Specifically, we estimate eligibility impact for black students and find that black students react more strongly to eligibility for subsidies. Black students are two times more likely to enroll in higher education in response to becoming eligible for subsidies than non-black students. We argue that this result could reflect a higher sensitivity of black students to subsidy availability. We also show that eligibility is increasing with income also for the sample of only black students. These results highlight the importance of allocation rules for subsidy programs. If subsidies are allocated according to academic performance and income is not a factor explicitly considered for allocation, higher income students are more likely to obtain subsidies, even when we consider a sample of students over-represented among low income students as it is the case of black students in Brazil.

Finally, we explore how eligibility for financial aid impact students' decision to invest in quality both at the program—major-institution—and at the institution level. In our setting, the supply of financial aid is constrained. Students apply for subsidies at the major-institution level and aid is distributed according to students' performance in the national standardized evaluation (ENEM). This framework might induce students to strategically choose lower quality programs in order to increase their chances of qualifying for aid. We show that eligibility for financial aid does not have a consistent impact on investment in quality at the major-institution level. On the other hand, we find that the impact on quality at the institution level is negative. This result is consistent with a framework in which students choose less selective institutions to qualify for financial aid to programs they believe are a better fit for their needs. We further explore this hypothesis, investigating if eligibility for aid impacts major choice.[1] To investigate if students adjust their investment decision between different programs by choosing specific majors, we estimate how eligibility for financial aid impacts major choice. We show that students eligible for aid are more likely to choose technical majors with higher than average costs of enrollment and labor market returns. Our results suggests that, in a setting in which students choose major during the application process, students eligible for financial aid tend to prioritize higher return majors over institutions' prestige.

Related Literature. This paper contributes to several branches of the literature. First, we contribute to a literature that evaluates the impact of in-kind subsidies on human capital investment decisions. According to Peltzman (1973), when in-kind subsidies are avail-

[1] In Brazil, students choose major during the college application process.

able, individuals must forgo entitlement to free education to invest in private education, which can distort decision making. Long (2006) builds on Peltzman's model to discuss how in-kind financial aid affects students' choices between colleges and shows that, when in-kind subsidies are large, students—specially lower income—choose public education even when there are significant differences in resources between public and private institutions. Long (2006) argues that students could benefit from a system that gives them freedom to choose between public and private provision in at least two ways. First, students would have more liberty to choose schools that are a better fit for their needs or preferences. Second, this system would create competition between higher education institutions, motivating public schools to more rapidly adapt to the changing requirements of effective skill formation. There is some research on how in-kind subsidies for public higher education can crowd-out private investment. Cellini (2009) and Cohodes and Goodman (2014), for instance, show that investment in subsidized lower quality programs grows with increases in the generosity of in-kind subsidies. Nevertheless, the evidence is still scarce. We contribute to this literature showing how students react when they are given the opportunity to choose how to apply subsidies between public and private institutions. In our framework, students are offered the possibility of applying subsidies for enrollment in private higher education. Some of the students eligible for these subsidies are also likely to qualify for public tuition-free higher education, having, thus, the chance to choose between public and private provision.

Our study also contributes to an extensive literature on how subsidies impact investment in higher education. The empirical evidence shows that financial aid has, in general, a positive impact on students' decision to enroll in higher education (Deming and Dynarski (2010) provide a review of this literature). A large share of students that enroll in higher education do not persist until graduation. In the U.S., only 60% of the students who began seeking a degree in a 4-year institution in 2012 graduated within a 6 years time frame (U.S. Department of Education, 2019). In Brazil, only 33% of students graduate with a bachelor's degree within the expected duration of the program. Students only fully accrue the benefits of higher education if they graduate.[2] There are several reasons why students might decide not to persist in higher education. The literature has explored the impact of different factors such as quality enhancing spending (Deming and Walters, 2017) or students' imperfect knowledge of their academic ability or of the returns to higher education (Arcidiacono et al., 2016). If financial hardship is one reason for dropping out,

[2]In Brazil, the average return to incomplete higher education is approximately one third of the return to a higher education degree (Ferreira et al., 2014)

financial aid may impact persistence. In fact, there is a growing body of evidence estimating the causal impact of financial aid on students attainment.[3] Nguyen et al. (2019) offer a systematic review of this literature. According to this review, additional $1,000 of grant aid improves year-to-year persistence by 1.2 percentage points.

In this article, we provide quasi-experimental evidence from two national programs designed to subsidize—partially or fully—the access of low to middle income students to private higher education in Brazil. This article builds on existing work on the impact of financial aid in a number of ways. First, we are able to identify the impact of subsidies for students around a threshold of academic performance not often studied in the literature. In our framework, eligibility for subsidized private higher education is restricted to students that have achieved a minimum level of academic performance on a national standardized evaluation. Contrary to the standard usually set by similar programs[4], the minimum requirement is set at the lower end of the national distribution of academic performance. Estimating the impact of subsidies around this threshold informs on how low-achieving students respond to financial aid. There is an extensive literature evaluating how high performing students respond to financial aid. The general conclusion is that aid increases enrollment and persistence for higher ability students (Avery and Hoxby (2003), Barrow et al. (2014), Cohodes and Goodman (2014), Andrews et al. (2020)). Both the costs and returns to higher education vary by students' ability (Belley and Lochner (2007)). Thus, it is not clear if lower ability students increase their enrollment in response to aid in the same way as higher ability students do. More importantly, it is not clear if these students are able to meet minimum academic requirements and persist. There is evidence that even low achieving students can benefit from higher education (Zimmerman, 2014). Much remains unknown about how these students respond to subsidies.

Second, our study design allow us to evaluate other components of students' choice. In our setting, students apply for financial aid at the major-higher education institution level. Each major-institution pair is expected to distribute financial aid to a given number of students. If there is excess demand, financial aid is distributed to those students with

[3]Using administrative data form Texas and exploring discontinuities in grant generosity for low income students, Denning et al. (2019) find that the U.S federal government aid program—Pell Grant—increases degree completion and later earnings. Bettinger (2015) explores variation in the amount of aid offered through Ohio state financial aid program. Other examples include Angrist et al. (2014), Alon (2011), Bettinger (2004), Andrews et al. (2020), Castleman and Long (2016), and Bettinger et al. (2019).

[4]Other papers that evaluate the impact of financial aid exploring discontinuities around a minimum academic requirement threshold, evaluate programs that require at least an above median performance (Bettinger et al. (2019), Scott-Clayton and Zafar (2019), Cohodes and Goodman (2014),Londoño-Vélez et al. (2020))

the highest grades in the national standardized evaluation. The application process is handled through an online systems administered by the government. The system informs students on the number of financial aid contracts available for each major-institution and students can apply to only a limited number of major-institutions. This system could lead to strategic behavior, with students choosing lower quality programs or less selective majors to increase their likelihood of qualifying for financial aid. The evidence on how financial aid impacts major choice or the choice between programs of different quality is mixed (Cohodes and Goodman (2014), Denning et al. (2019)). We contribute to this literature evaluating if eligibility for financial aid impacts students decision to enroll in specific majors or in programs of varying quality.

With our unique data we are able to handle some of the common limitations faced by the literature. First, we have access to a national registry of students enrolled in higher education. This means that we observe every student enrolled in every tertiary education institution in the country—either public, private non profit, or private for profit. Not being able to identify if students decided to enroll in an institution for which data are not available is one common shortcoming in the literature. Additionally, we have access to detailed information on students' characteristics. This gives us the opportunity to explore heterogeneities in response by students characteristics. There are a few papers exploring how gender (see Nguyen et al. (2019) for a review), social-economic status (Alon (2011), Angrist et al. (2014)) or race (Upton, 2016) impact students response to financial aid. The evidence is still inconclusive and more needs to be done to understand how students' background influences choice.

Finally, we provide evidence on the impact of subsidies at an emerging economy with low enrollment rates and profound inequalities in access to higher education. Despite some progress in the past decades[5], the tertiary education attainment rate among young adults in Brazil is only 19.59%. This is considerably lower than the attainment rate for OECD countries (43%) and for other Latin American economies.[6] As of 2013, students from the two lowest income quintiles accounted for only 14.5% of all enrollment, while students from the highest income quintile accounted for 40% of all enrollment (Ferreyra et al. (2017), OECD (2018)). The literature is mostly focused on investigating how different federal or state-level subsidies impact higher education in the US.[7] Investment in higher

[5]Tertiary education attainment rates among young adults–between the ages of 25 and 34—increased from 10% in 2010 to 19% in 2018.

[6]According to OECD data, in 2018,the tertiary education attainment rates among young adults in Argentina was 39.96%, Chile 33.73%, Colombia 28.96%, Costa Rica 27.82% and Mexico 23.36%.

[7]See Oppedisano (2011), Arendt (2008), Tanzi et al. (2020), Fack and Grenet (2015) for evidence for Europe

education is often considered an important driver for productivity and income growth. The institutional framework of a country can influence student's decision to invest in higher education and how they respond to subsidies. Despite a few recent efforts[8], the evidence on how students respond to subsidies for higher education in emerging economies is still scarce.

From a policy point of view, it is important to understand how students in Brazil respond to subsidies for higher education for at least two reasons. First, investment in skill formation is a crucial part of any policy that aims to increase the productivity of labor. Brazil's stagnant productivity levels are often considered one of the main culprits for the country's disappointing economic performance (Dutz (2018), Spilimbergo and Srinivasan (2019)). Understanding what impacts students' decision to invest in human capital is important for the design of productivity enhancing policies. Second, it is crucial to understand how low ability students react to these policies from an equity perspective. Investment in basic education in the country is highly correlated with parental income (Almeida and Packard, 2018). Performance at the national standardized evaluation is considerably worse for lower income individuals and for students from underrepresented groups.[9] In Brazil, students are not often given the opportunity to invest in their skill formation after joining the workforce. There is no two year college system in the country that can provide students the opportunity to further prepare for enrollment in a selective program and schools offering professional and technical degrees enroll only a limited number of students.[10] In this setting, high school graduates often have only two choices: to pursue a higher education degree or to enter the labor market as a low-skilled worker. Considering

[8]See Rau et al. (2013), Melguizo et al. (2016), Londoño-Vélez et al. (2020).

[9]In 2015, the average grade of all students who completed the national standardized evaluation for high school students (ENEM) was approximately 509. There is great variation in grade by students' background. Average grade for students previously enrolled in public high schools was 491 against an average of 578 for students enrolled in private schools. Grade is increasing with income. Splitting the sample of test takers by income quintiles, we have an average grade of 470 for students in the lowest quintile against a grade of 576 for students in the highest quintile. Grades also vary by race and gender. Students who identify themselves as black or brown underperformed in comparison with students who identify themselves as white—an average grade of 495 against 529. Female students also underperformed, even though this is likely due to composition bias. They represented the majority of test takers—58% of the sample—and got an average grade of 506 against an average grade of 514 for male students.

[10]Provision of upper secondary vocational training is limited in Brazil and admission is often selective. In 2017, only about 8% of students graduating from high school obtained a vocational training—against an average of 40% in OECD countries. Students from disadvantaged background are significantly less likely to enroll in vocational programs (OECD, 2019). At the post secondary level enrollment is also limited. According to data from the Higher Education Census, in 2017, only 12% of students enrolled in tertiary education were enrolled in a vocational program.

the large premiums for higher education in the country[11], a system that does not provide students the opportunity to access the gains of more education can hinder intergenerational mobility and help perpetuate the country's staggering inequality levels.

This article proceeds as follows. In section 2 we present the institutional setting of higher education in Brazil and detail the subsidy programs offered by the federal government. In section 3, we detail our unique data. Section 4 outlines our empirical strategy. In Section 5, we present our results and conduct some robustness checks. Section 6 presents a discussion of our findings and section 7 concludes this paper.

2 Institutional Framework

Higher education in Brazil is provided by both public and private institutions and it is regulated by the federal government. Historically, a large share of the federal budget for higher education has been disbursed funding highly selective tuition-free public federal institutions. Spending per student at these institutions is considerably higher than spending per students in countries of similar income and two to three times higher than spending per student at private institutions (World Bank, 2017). Despite the considerable investment, Brazil has performed poorly in international comparisons of performance in research and innovation.[12]

This strategy has also failed to include a large share of the population into higher education, especially students from a less privileged background. The public federal higher education system has been largely criticized for its regressive nature. Historically, public universities conducted need blind application processes. Institutions would admit only students who placed among the top performers in annual or biannual institution-specific exams—the *vestibulares*. Highly prepared students, who most likely had access to good schools and to the best educational resources, were more likely to get admitted into public institutions and obtain subsidies from the government. Poorer, less prepared students would not enroll in higher education or enroll in private schools and pay in full the cost of their education (World Bank, 2017).

[11] Even though returns on education have fallen in Brazil in the past decades (Ferreira et al. (2014), Montenegro and Patrinos (2014)), the return to higher education in the country is still considerably large. Ferreyra et al. (2017) estimate that the return to a higher education degree in Brazil is, on average, 125 percent. The average in Latin America is 104 percent

[12] In the 2018 Global Innovation Index of the World Intellectual Property Organization (WIPO), Brazil was ranked 64 out of 126 countries, behind countries like Chile, Turkey, Mexico, India, South Africa, Uruguay, and Colombia.

In the past decades, the policies for higher education in the country have changed considerably. First, the government established a national affirmative action policy designed to promote access of students from underprivileged backgrounds and from underrepresented minorities into public institutions.[13] The government also established a national centralized admission system, that reduced information asymmetries and application costs (Machado and Szerman, 2016). Finally, with the goal to increase national enrollment rates, the government created two programs designed to subsidize access to private higher education, a subsidized loan program—FIES—and a scholarship program—PROUNI.

Created in 1999[14], the federal student credit program— FIES[15]—was designed to provide subsidized credit for students enrolled in private higher education. Since its creation, the rules and regulations that govern the program have changed considerably. One of the most significant reforms occurred in 2010. The 2010 reform significantly reduced costs of participation for both students and institutions, without establishing a formal limit on the amount of loans to be disbursed through the program.[16] As a result, the number of loans disbursed through FIES increased considerably. The number of students enrolled in private higher education with FIES financing increased from a little over 130 thousand in 2009 to almost one and a half million in 2015.

The program soon began to face question on its cost-effectiveness and efficiency. FIES was an expensive program. A 2017 report by Brazil's Ministry of Finance[17] concluded that FIES costed taxpayers more than 21 billion Reais[18] in 2015 only. This represents approximately 70% of the costs of Brazil's flagship income redistribution program—Bolsa Família. The program's loose requirements on student's maximum income raised concerns on the regressive nature of the program.[19] The lack of a strict risk sharing mechanism with institutions raised concerns on incentives created and on the value added by institutions.

[13]For a more information on affirmative action policies in Brazil see Francis and Tannuri-Pianto (2012), Francis-Tan and Tannuri-Pianto (2018), Estevan et al. (ming), and Mello (2019).

[14]Executive Order n^o 1.856-5/1999, later replaced by Law n^o 10.260/2001

[15]*Fundo de Financiamento ao Estudante do Ensino Superior*

[16]Students benefited from a sharp cut in interest rates, changes in the repayment schedule, a significant increase in the maximum family income limit, the establishment of a rolling basis application process, and the creation of a government backed guarantee fund. Institutions benefited from a more straightforward tuition payment system and from a reduction in their exposure to default risks. For more details on the 2010 reform see De Mello and Duarte (2020)

[17]Available here: https://www.gov.br/fazenda/pt-br/centrais-de-conteudos/publicacoes/boletim-de-avaliacao-de-politicas-publicas/arquivos/2017/diagnostico-fies-junho-2017/view

[18]Approximately $ 3.8 billion.

[19]Before 2015, FIES was restricted only to students with a family income of more than 20 minimum wages.

Within a couple years, it became clear that the 2010 reform had serious shortcomings and that another reform was needed to increase the financial sustainability of the program. This reform began to take shape in the first semester of 2015, after a contentious presidential election. Between 2015 and 2017, the federal government introduced a set of new rules intended to reduce the disbursement of public funds and to target FIES' subsidies on worse-off students.[20]

The reform implemented new rules for the availability and distribution of funding among students. The Ministry of Education would conduct two annual selection processes for FIES, one for enrollment in the first semester and the other for enrollment in the second semester of each year. The selection process was centralized through a national online system. Through this system, students would apply for funding at the major-institution level. The system would inform students on the number of available contracts per major-institution. In case of excess demand, FIES contracts were to be distributed to those students with the highest grade in the national standardized evaluation (ENEM). The government also imposed more strict limits on the number of contracts available. The total number of loan contracts offered through FIES was to be determined by the availability of public funds.[21]

The government also imposed new requirements for students' eligibility. First, the government imposed a more strict income requirement. The program was redesigned to target lower income students. Only students with per capita family income lower than three times the minimum wage[22] could apply for a FIES loan.[23] The government also imposed a minimum academic performance requirement for eligibility.[24] The minimum academic performance requirement was based on students' performance in the national standardized evaluation for high schools students—ENEM—a large annual evaluation administered by the Ministry of Education. Specifically, only students with an average grade of at least 450 and with essay grade higher than zero in any ENEM exam conducted after 2010 were to be considered eligible for FIES. As it will be detailed in section

[20] By the second semester of 2017, the program was, once again, completely reformulated. Considering that our empirical investigation does not cover this period we will not detail the 2017 reform

[21] Before the 2015 reform, students could apply for FIES at any point of the academic year and academic performance was not considered a factor for funding distribution. There was no formal limit on the number of available contracts.

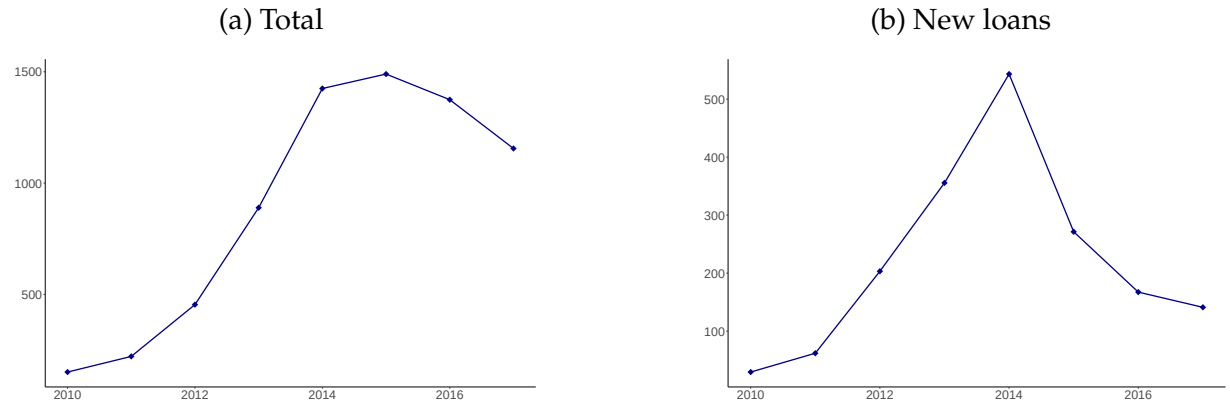
[22] Approximately $450.00 per capita.

[23] The limit was initially set at one and a half times the minimum wage. In 2016, the government increased the income limit to two and a half and then three times the minimum wage.

[24] There were a few exceptions to these rules. First, primary teachers employed by public schools were exempt of both the income and the minimum performance requirement. For the 2015 selection processes, students that had not taken any ENEM exam starting 2010 were exempt from the performance requirement.

4, this minimum performance requirement is central to our identification strategy. Figure 1 shows that with the 2015 reform there is a considerable reduction in program's size. Between 2014 and 2017, the number of new loans disbursed through FIES decreased by 60%.

Figure 1: Enrollment with FIES loans



Notes: This figure illustrates the number of students enrolled with FIES loans between the years of 2010 and 2017 in thousands of students. Panel (a) illustrates the total number of students enrolled with FIES and panel (b) illustrates the number of freshman students enrolled with FIES. The data source is the Higer Education Census from INEP and the FIES data from FNDE.

The federal scholarship program—PROUNI[25]—offers full and partial scholarships to low to middle income students enrolled in private institutions. Higher education institutions that choose to participate in PROUNI are required to enroll a specific number of students with full and partial scholarships in majors deemed of sufficient quality according to the Ministry of Education annual evaluations.[26] In return, the institutions are considered exempt from a set of taxes and federal contributions.[27] Figure 2 illustrates the number of scholarships distributed through PROUNI between 2010 and 2017. In 2017, approximately 500 thousand students were enrolled in private higher education with a PROUNI scholarship. This represents approximately half the number of students enrolled

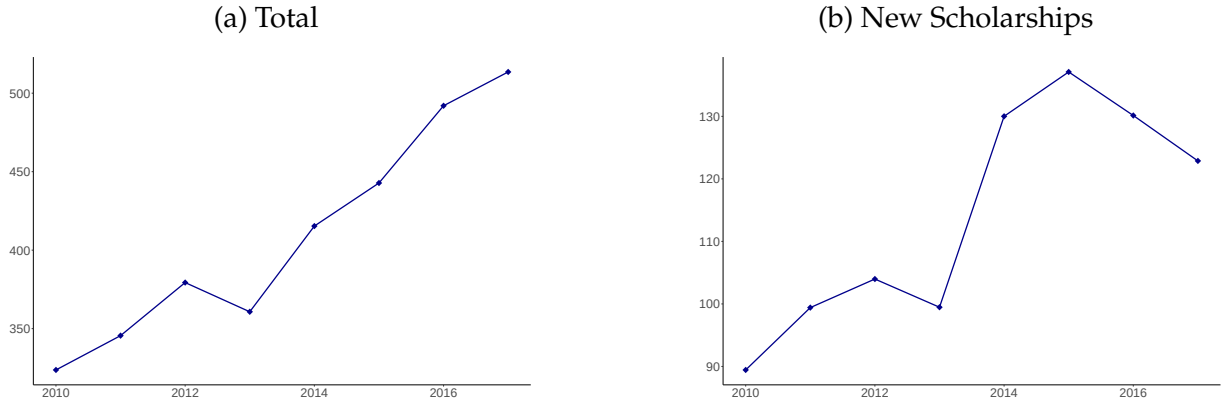
[25]Programa Universidade para Todos

[26]Major-institution pairs considered of insufficient quality according to the annual evaluation conducted by the Ministry of Education for two consecutive evaluations are disqualified from the PROUNI program. The scholarships of disqualified majors-institutions are to be redistributed across majors within the institutions.

[27]Institutions are exempt of paying taxes on income—Imposto de Renda das Pessoas Jurídicas (IRPJ)—a tax on profit—Constribuição Social sobre o Lucro Líquido—and two special contributions—Contribuição Social para o Financiamento da Seguridade Social and Contribução para o Programa de Integração Social.

with FIES in the same period.

Figure 2: Enrollment with PROUNI scholarships (thousand)



Notes: This figure illustrates the number of students enrolled with PROUNI scholarship between the years of 2010 and 2017 in thousands of students. Panel (a) illustrates the total number of students enrolled with PROUNI and panel (b) illustrates the number of freshman students enrolled with PROUNI. The data source is the Higer Education Census from INEP.

Students must meet a set of requirements to be considered eligible for PROUNI. First, the program is only available to students that meet a maximum income requirement. Full PROUNI scholarships are available to students whose per capita family income is less than one and a half minimum wage. Partial scholarships—that cover 50% or 25% of tuition—are available for students with slightly higher income levels. Second, scholarships are only available to students who graduated from high school from a public school or from a private school with full scholarship.[28] To apply for a scholarships in any given year, students are required to have participated in the previous year national standardized evaluation (ENEM). Starting 2013, the program imposed a minimum academic ability requirement for eligibility. Only students with an average ENEM grade of 450 points or higher and with an essay grade higher than zero were to be considered eligible for the program. As with FIES, the application process for PROUNI is conducted through an online national system. In the application process, students choose to apply for a given set of major-institution pairs. Available scholarships are distributed to applying students according to their average grade in ENEM, with priority given to students who get higher

[28]There are two exceptions to this rules. Students with disability or students who are currently teachers at a public school and that intend to use the scholarship to enroll in a education major.

grades.[29]

There are a few similarities between FIES and PROUNI. Both programs have in common the fact that they offer federally funded subsidies for enrollment in private higher education to students that meet a common minimum academic requirement—obtain a grade of at least 450 on the country's evaluation of high school students (ENEM). They also use a similar system to allocate subsidies. For the period that we consider in our analysis, both programs allocated subsidies trough an online system that allowed students to apply for subsidies at the major-institution level and that selected students based on their performance on the ENEM evaluation. Nevertheless, it is important to highlight some of the significant differences between these two programs.

From the students' perspective, the main difference between FIES and PROUNI is the size of the subsidy. PROUNI works as an unconditional grant. Students who are admitted into private higher education with a PROUNI scholarship are exempt from paying tuition costs for the full duration of the course.[30] FIES, on the other hand, is a subsidized credit program. Students admitted with FIES funding must repay the cost of their education after graduation at a subsidized interest rate. From the students' perspective, PROUNI is a much more generous program. One would expect the demand for PROUNI scholarships to be stronger than the demand for FIES funding among students eligible for both programs. Given that subsidies are distributed according to academic performance, the difference in subsidy size could result in differences in academic readiness of students enrolled with both programs. The available data reveals that students enrolling with PROUNI are, on average, more academically prepared than students enrolling with FIES both at the moment of application and while enrolled. Between 2015 and 2016, the average minimum ENEM grade required to obtain a PROUNI scholarship—588.4—was much higher than the average minimum ENEM grade required to obtain FIES funding—536.7. Using data from the 2015 ENADE exam—an annual evaluation of students enrolled in higher education in Brazil—we find that students enrolled in higher education with PROUNI have much higher average grade—50.28—than students enrolled with FIES—41.92.

The second significant difference between the two programs is the socioeconomic profile of targeted students. PROUNI was designed from the start as a program that would

[29] In case there is a shortage of demand for a particular major-institutions the remaining slots available for PROUNI will be redistributed through a second stage application process. In this stage, students that meet the income requirements and that have taken any ENEM test since 2010 can apply.

[30] Students who do not meet minimum academic performance requirements—fail more than 25% of their credits—while enrolled can loose their scholarship.

benefit students from underprivileged backgrounds. The program is restricted to students whose families have per capita income lower than 1.5 minimum wages and that graduated from a public high school or a private high school with full scholarship. PROUNI also has an affirmative action arm. Institutions participating in PROUNI are required to reserve a share of their scholarships to students from underrepresented minorities—black, brown, indigenous, and students with disabilities.[31] FIES, on the other hand, was designed as a policy intended to increase enrollment rates in private higher education. Between 2010 and 2015, FIES was only unavailable for students with a family income of more than 20 minimum wages, a requirement that would only restrict access to funding for students at the very top of the country's income distribution. In the 2015 reform, the government established a more strict income requirement. Specifically, FIES was restricted to students with per capita family income lower than three times the minimum wage—this represents approximately the percentile 90 of the country's household per capita income distribution and is two times higher than PROUNI maximum income level. Even after the 2015 reform, other socioeconomic factors would not be considered relevant for funding allocation.

The method through which the government compensates higher education institutions that participate in PROUNI and FIES is another important difference. According to PROUNI rules, higher education institutions are considered exempt from some taxes and federal contributions if they admit a minimum number of students with full or partial scholarships every year. According to this scheme, higher education institutions do not financially benefit from increasing the number—or the persistence—of students with PROUNI scholarships. The compensation for students enrolled with FIES is very different. For every student currently enrolled with FIES the government transfers to the institution treasury bonds with face value corresponding to the financed tuition. The bonds are tradable for Social Security obligations and the government holds regular repurchase auctions. Government transfers are, thus, a direct function of the number of students currently enrolled with FIES. The differences in compensation schemes create differences in expected revenue per student for each program. The evidence suggests that, even though different types of higher education institutions enroll at least some students with both FIES and PROUNI, for profit institutions are more likely to admit large numbers of students with FIES funding. In 2015, around 7% of students enrolled in private higher education were enrolled with a PROUNI scholarship at both for profit and non profit institutions. Students with FIES, on the other, comprised 29% of students enrolled in for

[31] The share of scholarships reserved to minority students depends on the share of minority population within each state.

profit institution against 19% of students enrolled in non profit institutions. Students with FIES are also less likely to enroll in Brazil's universities—institutions that have regulatory autonomy and conduct research. In 2015, only 31.6%. of the students with FIES funding were enrolled in universities while 42.6% of students with PROUNI were enrolled in universities.

Finally, there are significant differences in how the government allocates funding through FIES and PROUNI. The general rule for PROUNI allocation is that higher education institutions must admit at least one student with full scholarship for every ten students enrolled in each major.[32] The number of scholarships available are then a function of number of enrolled students at the major level. The number of student loan contracts offered through FIES, on the other hand, are determined through negotiations between the government and higher education institutions. Every semester, the government presents a plan for funding allocation giving priority to regional development concerns, higher quality majors, and majors considered strategic. Higher education institutions can then present a proposal on how they would like to allocate funding across majors, based on their specific needs and government defined criteria. Higher education institution thus have some flexibility to allocate available subsidies to higher demand majors. The government must approve each institution's proposal.

In 2017, approximately 26% of the students enrolled in private higher education in Brazil received subsidies from either PROUNI or FIES. Despite the size and relevance of these programs, there are few systematic evaluations of their impact.[33] In this paper, we explore the fact that both PROUNI and FIES established the same minimum academic requirement for eligibility—a minimum grade of 450 on the national exam for high school students (ENEM)—to investigate how subsidies for higher education impact the choice of academically marginal students.

3 Data

In this paper, we investigate if students change their behavior in response to being considered eligible for private higher education subsidies. As we detailed in section 2, Brazil's

[32] Institutions can choose to offer some partial scholarships instead of full scholarships. There is a rule determining how many partial scholarships must be offered by number of enrolled students. If a major is considered of insufficient quality by the Ministry of Education, the scholarships that should have been offered for this major must be redistributed across the other majors offered by the higher education institution.

[33] Dearden and Nascimento (2019) are an exception.

federal government subsidize access to private higher education through two national programs: a scholarship program—PROUNI—and a subsidized lending program—FIES. To apply for any of these two programs, students must meet a few requirements. In particular, students must obtain a minimum average grade of 450 in the national standardized evaluation for high school students (ENEM). We estimate the causal impact of subsidy availability on students' human capital investment decisions exploring the discontinuity in eligibility around this minimum academic performance threshold. To implement this empirical strategy, we need two sets of information. First, we need information on students performance at the national standardized evaluation (ENEM). Second, we need to link this information to information on students' educational decisions in the years following the exam. We obtain these data by merging two data sets with information at the student level: the ENEM exam individual data and the Higher Education Census.[34]

Brazil's national standardized evaluation for high school students—ENEM[35]—is administered by the Ministry of Education and takes place once every year. Participation in the exam is voluntary and it is open to students that are expected to graduate from high school in the year of the exam and students that have graduated from high school in previous years.[36] Approximately 5 million students take the ENEM exam every year, making it one of the largest high school exams in the world (Travitzki et al., 2014). ENEM is considered an important part of the college admission process in Brazil. Several higher education institutions in the country—both public and private—consider grades from ENEM in their admission processes.[37] During the exam, students must answer 180 multiple choice questions equally divided into four different areas: language, human sciences, natural sciences and math. Students must also write an essay on a given topic. In each of these areas, students are assigned a grade from 0 to 1000. The average ENEM grade is given by the simple average of students' grade at each area, including the essay grade. As detailed

[34]The ENEM student data and the Higher Education Census are administered by INEP—an independent government agency linked to Brazil's Ministry of Education—and are publicly available (http://inep.gov.br/microdados). Personal identifiers required to merge these two data sets are not included in the public version. INEP authorizes researchers with an approved research project to access a merged version of the data. Access is only available through hardware located at a room for access to sensitive information at INEP's headquarter in Brasília (more information here: http://inep.gov.br/dados/sedap).

[35]Exame Nacional do Ensino Médio

[36]Between 2009 and 2016, students that had not graduated from high school could take the ENEM exam and use their grade to obtain a high school certificate. Students that are not expected to graduate from high school in the year of the exam can also take it for training purposes.

[37]in 2017, 21% of new students enrolled in higher education in Brazil were admitted through a process that used ENEM grades as reference.

in section 2, students are required to obtain a minimum average grade of 450 to qualify for subsidies for private higher education.

Information on students' individual performance on each ENEM area is available through the ENEM exam individual data. This data set also contains basic administrative information on students' background such as age, gender, race and information on a student-level survey. The ENEM survey includes information on a categorical measure of family income. ENEM data are available from 1998 to 2019. As detailed in section 2, the minimum performance requirement for eligibility for the subsidized credit program was established in the second semester of 2015 and, in 2017, the credit program underwent another major reform. For this reason, we restrict our analysis to the cohorts of high school graduates making the decision to enroll in higher education between 2015 and 2016, i.e, the cohorts taking the ENEM exam between 2014 and 2015.

The minimum ENEM grade is not the only requirement for eligibility for subsidies. In order to be considered eligible, students need to obtain a grade higher than zero on ENEM's essay. We restrict our sample to students that meet this requirement. Students also need to satisfy a maximum family income requirement. We do not have access to detailed income information and, for this reason, we do not restrict our sample on income basis. Finally, we restrict our analysis to students that graduated from high school in the same year they took the exam. We focus on high school seniors for mainly two reasons. First, this allow us to exclude from our analysis students that might be retaking the exam with the sole purpose of obtaining the minimum grade required for eligibility (Solis, 2017). Second, the rules that determine eligibility for subsidies are slightly different for the credit and the scholarship programs. To be eligible for the credit program, students must obtain the minimum grade of 450 in any ENEM exam starting from 2010. To be eligible for the scholarship program, students must obtain the minimum grade in the previous year exam. For seniors that are choosing to enroll in higher education right after high school, the minimum academic requirement rule is the same for both the loan and the scholarship programs.

Our final sample contains nearly 3 million observations. Table 1 details the distribution of ENEM grade for the students in our final sample. The average ENEM grade is 509.09. Students, on average, perform better on the human sciences and language exams. The math exam seems to be the most challenging for students. It is the exam with the lowest average grade and the highest variance. The minimum grade for eligibility—450—represents approximately the 23rd percentile of the distribution of ENEM grade. Thus, the minimum academic performance requirement impacts the decision of students

in the lower end of the distribution of academic ability.

Table 1: Descriptive Statistics - ENEM Grade Distribution

Variable	(1) Mean	(2) S.D.	(3) Min	(4) p(25)	(5) p(50)	(6) p(75)	(7) Max
Average Grade	509.09	76.59	44.00	454.62	499.62	553.92	900.00
Grade - Natural Sciences	482.81	74.42	0.00	427.20	474.00	529.50	876.40
Grade - Human Sciences	551.91	72.02	0.00	505.30	557.10	601.10	862.10
Grade - Language	507.95	70.86	0.00	462.70	511.80	556.80	825.80
Grade - Math	476.81	109.22	0.00	396.50	454.10	534.00	1008.30
Grade - Essay	526.30	145.03	40.00	440.00	520.00	600.00	1000.00

Notes: This table presents the distribution of ENEM grade for students in the final sample. The final sample includes all students taking the ENEM exam between 2014 and 2015 who are expected to graduate from high school in that same year and who obtained a grade higher than zero on ENEM's essay—2,876,864 students total. Column (1) represents the sample mean, column (2) the standard deviation, column (3) the minimum sample value, columns (4), (5), and (6) the percentiles 25, 50 and 75 consecutively, and column (7) the maximum sample value. The first row present students' average performance on ENEM—the simple average across all area assessed by ENEM, including the essay. Eligibility is determined according to students' average performance. The following rows, detail students' performance on each specific area.

Table 2 presents descriptive statistics for the students in our sample. A little more than half of the students in our final sample are female (58 %), 10% of them identify as black, and 77% are expected to graduate from a public high school. The average age is 18, consistent with the average age of students graduating from high school in Brazil. Roughly 53% have a car at home and 70% have access to internet. From ENEM data, we have access to a categorical variable that represents parental education—from 1, less than secondary education education, to 3, college degree or higher. We also have access to a categorical variable representing family income. Students can self report if their family income is within a given set of intervals, e.g. less than one minimum wage, between one and one and half minimum wages, between one and a half and two minimum wages. We use the median value in each of these intervals and the reported household size to obtain a rough measure of per capita family income.

In table 2, we also present descriptive statistics for students within an 100 points range around the minimum threshold for eligibility, i.e. students who obtained an average grade between 400 and 500. Students within this interval are more likely to be female (61%), black (12%), and to be expected to graduate from a public high school (90%). Students within this interval are also less privileged than students from the full sample according to all socioeconomic variables available.

Table 2: Descriptive Statistics - Students' Characteristics

Variables	(1) Mean	(2) N	(3) Mean [-50, 50]	(4) N [-50, 50]
Female Student	0.583	2,876,864	0.614	1,276,294
	(0.493)		(0.487)	
Black Student	0.107	2,836,669	0.126	1,258,667
	(0.310)		(0.331)	
Graduating from Public High School	0.770	2,874,649	0.901	1,275,222
	(0.421)		(0.299)	
Student Age	18.208	2,876,795	18.707	1,276,271
	(3.741)		(4.453)	
Has a Car at Home	0.533	2,875,091	0.424	1,275,285
	(0.499)		(0.494)	
Has Internet Access	0.703	2,875,077	0.598	1,275,281
	(0.457)		(0.490)	
Father Education	1.590	2,599,397	1.371	1,122,647
	(0.728)		(0.591)	
Mother Education	1.720	2,757,266	1.501	1,205,852
	(0.764)		(0.666)	
Family Income	4.543	2,875,097	2.220	1,275,287
	(12.542)		(4.499)	
Household Size	4.148	2,875,097	4.268	1,275,287
	(1.405)		(1.514)	
Per Capita Family Income	1.215	2,875,097	0.582	1,275,287
	(3.526)		(1.257)	

Notes: This table presents descriptive statistics for the final sample. Columns (1) and (2) present descriptive statistics for the full sample. Columns (3) and (4) present descriptive statistics for students with average grades between 400 and 500—an 100 points interval around the minimum performance threshold. Columns (1) and (3) present the variable mean and standard deviation (in parenthesis). Columns (2) and (4) presents sample size. Variables *Female Student*, *Black Student*, *Graduating from Public High School*, *Has a Car at Home*, and *Has Internet Access* are binary variables. *Mother Education* and *Father Education* are categorical variables that take the value of 1 if the parent has less than secondary education education, 2 if the parent has secondary education and 3 if the parent has a college degree or higher. *Family Income* is a categorical variable representing different income intervals as multiples of the national minimum wage. We use the median value in each of these intervals and the reported household size to calculate *Per Capita Family Income*.

From the Higher Education Census, we obtain information on students' decision to

enroll in higher education after graduating from high school. Every year, the Higher Education Census collects information from all higher education institutions in the country—public and private. The Census contains information at the institution, major, instructor and student level. At the institution level, the Census collects information on academic and administrative personnel, financial information, and information on the different majors offered by each institution. At the major-institution level, the Census collect information on number of credits required for graduation, minimum length of program, number of applicants per type of application process, number of enrolled students, number of dropouts, and number of graduates. Students' data include demographics and information on financial aid by source and type. For instructors, we have data on demographics, education, and employment type.

The Census contain information on students enrolled in every higher education institution in the country. Thus, we can use it to identify if students decided to enroll in higher education after taking the ENEM exam between 2014 and 2015. Due to restrictions in data access, the latest information available is from the 2017 Census. We use information from the 2015, 2016, and 2017 Census to learn about students' decisions up to three years after taking the ENEM exam. Table 3 presents this information for students in our final sample. Approximately 21% of the students in our sample enroll in higher education, 14% in private institutions and 7% in public institutions. Table 3 also indicates the percentage of students that persist after initial enrollment. Considering public and private institutions, 17% of the students in our sample persist after one year and 13% persist after two years of initial enrollment. That means that of the students that actually enroll, roughly 83% persist after one year and only 65% persist after two years. Persistence rates are higher for public institutions—88% after one year and 72% after two years against 81% after one year and 62% after two years for private institutions. Considering our full sample, 4.5% of students persist after three years. Since we only have information on persistence after three years for about half of our sample—students who took the ENEM exam in 2014—this is an imperfect measure of persistence.

Table 3 indicates that the private sector enrolls a large share of the higher education students in our sample. Approximately 67% of the students in our sample that enroll in higher education, enroll in a private institution. It also shows that publicly provided financial aid is an important feature of the private higher education. Approximately 6.4% of the students in our sample fund at least part of their enrollment in private higher education with some form of state subsidy—3.4% from the credit program (FIES) and 3% from the scholarship program (PROUNI). Thus, almost half of the students in our sam-

ple that enroll in private higher education have access to some form of financial aid from the government. In the next sections, we explore the role financial aid play on students' decision to invest in higher education.

Table 3: Descriptive Statistics - Students' Decision to Enroll in Higher Education

Variable	Mean	Std. Dev.
Enroll in Higher Education - Total	0.212	0.409
Persist after one year - Total	0.178	0.382
Persist after two years - Total	0.139	0.346
Persist after three years - Total*	0.045	0.207
Enroll in Higher Education - Private	0.144	0.351
Persist after one year - Private	0.117	0.322
Persist after two years - Private	0.09	0.287
Persist after three years - Private*	0.026	0.16
Enroll in Higher Education - Public	0.068	0.251
Persist after one year - Public	0.060	0.238
Persist after two years - Public	0.049	0.216
Persist after three years - Public*	0.018	0.135
Enrolled with FIES	0.034	0.180
Enrolled with PROUNI	0.030	0.170
Enrolled with PROUNI (Partial scholarship)	0.009	0.093
Enrolled with PROUNI (Full scholarship)	0.021	0.143
Obs.	2,876,864	

Notes: This table presents enrollment and persistence information for the final sample. Information is obtained from the Higher Education Census from 2015 to 2017. It presents information on the proportion of students deciding to enroll and persist in public and private higher education up to three years after initial enrollment. It also contains information on the proportion of students enrolling in private higher education with some form of government funded subsidy. Due to data limitation, We do not observe the value of variables market with * for students from who took the ENEM exam in 2015.

4 Empirical Strategy

In this paper, we estimate the impact of eligibility for subsidized private higher education on the human capital investment decisions of low-ability students in Brazil. As detailed

in section 2, to be considered eligible for public subsidies for private higher education, students must obtain a minimum grade of 450 in the national standardized evaluation for high school students (ENEM). We exploit this eligibility requirement—through a Regression Discontinuity Design—to estimate the causal impact of eligibility on students' choices.

A Regression Discontinuity Design (RDD) can be used when treatment assignment is determined as a function of an observed variable. In our case, treatment—eligibility for financial aid—is a function of students performance on an standardized evaluation. Only students that cross a given performance threshold—students who obtain an ENEM grade higher than 450—can be considered eligible for financial aid. If individuals are unable to manipulate the assignment variable, variation in treatment near the threshold is as good as random. If no other relevant factor varies discontinuously around the threshold, differences in outcome around the threshold are caused by the treatment. In this framework, we can estimate treatment effect by comparing the choices of individuals just above and just below the established threshold.

To estimate the treatment effect, we implement a data driven non parametric version of the RDD. The non parametric version reduces the risks associated with model specification.[38] We compute treatment effects estimating a local polynomial non-parametric regression for observations within a bandwidth defined according to the optimal bandwidth selection procedure proposed by Calonico et al. (2015). Specifically, we estimate the parameters of the following model on a subset of the data within a chosen bandwidth to the left and right to the eligibility threshold:

$$Y_i = \alpha + \beta_0 T_i + \beta_1 r_i + \beta_2 r_i T_i + \epsilon_i \tag{1}$$

Here Y_i represents the outcome variable, T_i a binary variable indicating students who are eligible and ineligible for aid—i.e., students who crossed the eligibility threshold—and r_i represents the assignment variable—the ENEM grade.

The validity of an RD approach depends on two basic assumptions. The first assumption states that individuals are not able to precisely control the assignment variable around the treatment assignment threshold. In our framework, eligibility is determined according to students' average grade in the national standardized evaluation for high school students (ENEM). Only students who obtain a grade of 450 or higher are considered eligible for financial aid. If students could manipulate ENEM grade, students interested

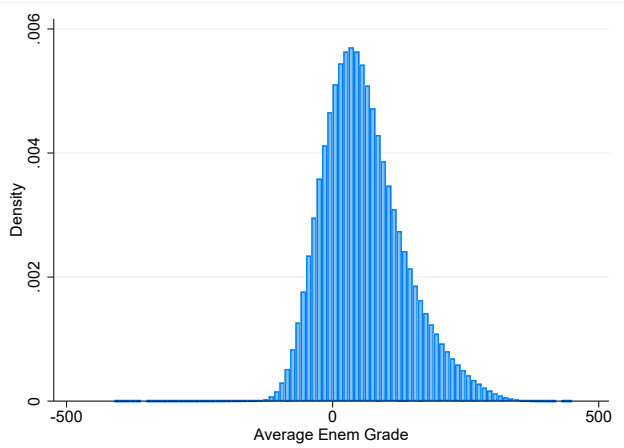
[38] Results for the parametric version are similar and available upon request.

in enrolling in higher education with financial aid could improve their grades and increase their chances of participating in the program. Thus, our identification strategy relies on the assumption that students are unable to control their grade around the eligibility threshold. In our framework, this is likely the case. ENEM plays a central role in the admission process for higher education in Brazil and several safety measures are taken by the government to guarantee that students are not manipulating their results. Every student in the country takes the same exam in the exact same day under strict anti-cheating measures. The exam's answer are publicized right after the test and multiple choice questions are graded with the use of a computer program. ENEM's essays are evaluated through blind grading.

Given our institutional framework, it is unlikely that students are able to manipulate their ENEM grade. Either way, we can use our data to assess the robustness of this assumption. In figure 3, we plot the histogram of ENEM's average grade, standardizing the average grade around the eligibility threshold. The histogram can be used to evaluate if there is any discontinuity in ENEM grade around the minimum performance threshold. If students could manipulate their grade, we would expect to see some bunching around zero. Figure 3 shows no visible discontinuities in the distribution of ENEM's grade. We also implement a formal manipulation testing procedure using the local polynomial density estimators proposed in Cattaneo et al. (2018).[39] Figure 4 illustrates the result of this test. Again we find no evidence of manipulation around the eligibility threshold.

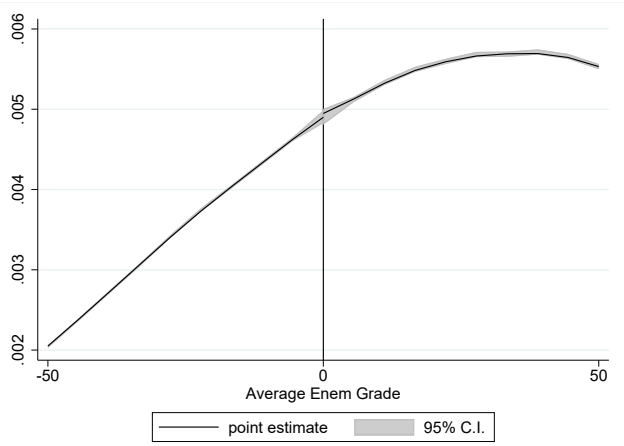
[39]For more information on manipulation testing see McCrary (2008).

Figure 3: Histogram - ENEM Average Grade



Notes: This figure presents a histogram of ENEM grade for students in the final sample. The final sample includes all students taking the ENEM exam between 2014 and 2015 who are expected to graduate from high school in that same year and who obtained a grade higher than zero on ENEM's essay—2,876,864 students total. In this figure, we standardize ENEM grade around the minimum threshold requirement. Thus, the grade zero represents the minimum threshold for eligibility—originally 450 points. The histogram starts at grade -500 and bins width is specified at 10 points.

Figure 4: Manipulation Test - ENEM Average Grade



Notes: This figure presents the results a manipulation test for ENEM grade considering the students in our final sample. The final sample includes all students taking the ENEM exam between 2014 and 2015 who are expected to graduate from high school in that same year and who obtained a grade higher than zero on ENEM's essay—2,876,864 students total. In this figure, we standardize ENEM grade around the minimum threshold requirement. Thus, the grade zero represents the minimum threshold for eligibility—originally 450 points. We implement a manipulation test based on a local polynomial density estimator technique as proposed by Cattaneo et al. (2018). Results show no evidence of manipulation around the minimum eligibility threshold at a 95% confidence interval.

For identification, we need variables unrelated to treatment to vary smoothly with respect to the assignment variable around the minimum eligibility cutoff. If the distribution of individual characteristics jump around the treatment threshold we are not able to identify treatment effect. To evaluate if other factors—besides treatment—vary discontinuously around the minimum threshold we evaluate how variables determined at the baseline period vary with the assignment variable. If all other relevant factor vary continuously around the threshold, the value of individual characteristics determined before treatment should not be affected by treatment. We test this assumption implementing a non-parametric Regression Discontinuity for all of the observed covariates in our sample. Table 4 presents the results of this exercise. For all baseline variables, there is no significant discontinuity around the minimum performance threshold.

Table 4: Test for Discontinuity in Covariates

Variables	(1) Linear	(2) Linear (Robust)	(3) Quadratic	(4) Quadratic (Robust)
Female Student	-0.002	-0.003	-0.004	-0.004
	(0.002)	(0.003)	(0.003)	(0.003)
Black Student	0.001	0.001	0.001	0.001
	(0.001)	(0.002)	(0.002)	(0.002)
Graduating from Public H.S.	0.001	0.001	0.001	0.001
	(0.001)	(0.002)	(0.002)	(0.002)
Student Age	0.005	0.003	0.003	0.000
	(0.022)	(0.026)	(0.026)	(0.029)
Has Car at Home	0.001	0.001	-0.001	-0.002
	(0.002)	(0.003)	(0.003)	(0.003)
Has Internet Access	-0.001	-0.002	-0.002	-0.003
	(0.002)	(0.003)	(0.003)	(0.003)
Father Education	-0.004	-0.005	-0.005	-0.006
	(0.003)	(0.003)	(0.004)	(0.004)
Mother Education	-0.003	-0.002	-0.003	-0.004
	(0.003)	(0.004)	(0.004)	(0.004)
Family Income	0.008	0.014	0.011	0.011
	(0.020)	(0.023)	(0.024)	(0.027)
Household Size	0.005	0.006	0.008	0.009
	(0.007)	(0.008)	(0.008)	(0.009)
Per Capita Family Income	0.001	0.002	0.002	0.001
	(0.006)	(0.007)	(0.007)	(0.008)

Notes: This table presents the results of a regression discontinuity design on the baseline characteristics of students in our final sample. The final sample includes all students taking the ENEM exam between 2014 and 2015 who are expected to graduate from high school in that same year and who obtained a grade higher than zero on ENEM's essay—2,876,864 students total. In each row, we test whether crossing the eligibility threshold has a significant impact on a given baseline characteristic. Variables names are given in the first column. We implement a data driven non parametric version of the RD design (Calonico et al., 2015). Across columns we assess the robustness of our results using local polynomial estimators of various orders—columns (1) and (2) linear and columns (3) and (4) quadratic—and implementing a bias-corrected robust inference procedure (Calonico et al., 2014)—columns (2) and (4). For all baseline variables, there is no significant discontinuity around the minimum performance threshold.

5 Results

In this paper, we explore discontinuities in eligibility for subsidies for private higher education to assess how financial aid impact the decisions of low-ability students. As detailed in section 2, Brazil's federal government subsidize access to private higher education through two national programs: a student loan program—FIES—and a scholarship program—PROUNI. Both FIES and PROUNI require students to meet a minimum academic performance eligibility requirement. Specifically, students are required to obtain a minimum grade of 450 on the national evaluation for high schools students (ENEM).

Ideally, we would like to estimate how the availability of financial aid impact students' behavior. With the available data, we observe the students who meet the minimum academic performance eligibility requirement. We are not able to identify which students were actually given the opportunity to obtain financial aid. Not every student that reaches the minimum academic performance threshold meets the other requirements for eligibility. First, financial aid is not available for students whose family income crosses a given maximum income threshold. We do not have precise information on students' family income and are, thus, unable to restrict our analysis to students who meet the income eligibility requirement. Second, the supply of financial aid is constrained. Subsidies are distributed at the major-institution level. Students apply for financial aid through an online system that details the number of contracts available at each major-institution. If the number of applicants is higher than the number of available contracts, financial aid is distributed according to students' performance in the national standardized evaluation. Our data provides information on final matches—i.e. we observe if a student enrolled in a given major-institution. We do not have information on students' application process. Thus, we are not able to identify students who did not have access to financial aid due to excess demand in their major-institution of choice.

Given the limitations of our data, we are not able to directly estimate the impact of financial aid availability on students' behavior. Nevertheless, we can uncover the impact of crossing the minimum academic requirement for eligibility. For this reason, we focus on evaluating the impact of eligibility on students' choice. We adopt a very conservative approach and assume that all students who meet the minimum academic performance requirement could be eligible for financial aid. All estimates obtained under this assumption should be considered a lower bound of the actual impact of aid availability.

Financial Aid. To assure that the eligibility effect we are estimating on students' behavior is related to availability of financial aid, we need to verify if students who do not meet the

eligibility requirement are actually constrained in their ability to obtain subsididies from the government. To investigate if this is the case, we analyze how access to financial aid varies around the minimum academic performance threshold for eligibility. We estimate the impact of eligibility—as detailed in section 4—on a variable that indicates if the student enrolled in private higher education with financial aid. Table 5 details the results of this test. Crossing the minimum academic performance threshold required for eligibility increases the likelihood of obtaining government sponsored financial aid by 1 percentage point. Considering that only 6.4% of the students in our sample enroll in higher education with financial aid, this value represents a 15.6% increase from the sample average. Table 5 also reveals that the impact is positive and significant for all forms of financial aid, although stronger for the student loan program—FIES.

To further evaluate if the eligibility requirement is an actually binding constraint, we need to verify if students with grades below the eligibility threshold are able to obtain financial aid. In figure 5 we illustrate how access to financial aid varies with ENEM grade. Figure 5 reveals that students below the eligibility threshold are highly unlikely to obtain any type of financial aid.[40] It also shows a clear discontinuity in access to financial aid for students that cross the eligibility threshold.

[40] As detailed is section 2, FIES applies a few exceptions to the minimum academic performance requirement.

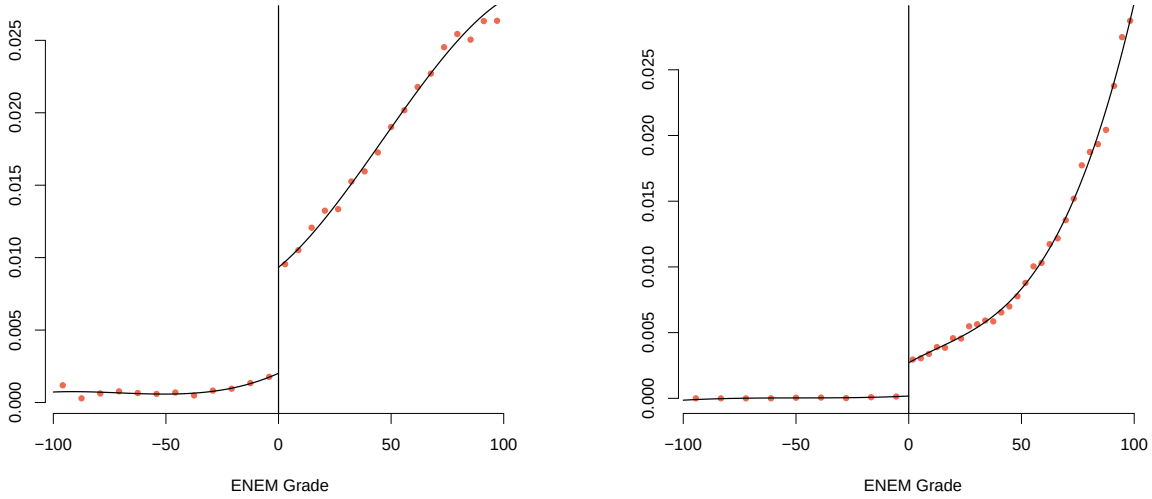
Table 5: Eligibility Effect: Financial Aid

Variables	Financial Aid	FIES	PROUNI	PROUNI (Full)	PROUNI (Partial)
Coeff	0.010 ***	0.007 ***	0.003 ***	0.002 ***	0.001 ***
SE	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
BW	26.953	32.565	45.675	39.067	56.684
Local-Poly.	1	1	1	1	1
N	727994	870383	1181442	1028368	1414984
Coeff	0.011 ***	0.007 ***	0.003 ***	0.002 ***	0.002 ***
SE	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
BW	53.975	62.031	45.803	50.912	50.102
Local-Poly.	2	2	2	2	2
N	1359950	1518814	1184556	1296095	1278944
Coeff	0.010 ***	0.007 ***	0.003 ***	0.002 ***	0.002 ***
SE	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)
BW	78.091	114.356	70.159	69.724	86.916
Local-Poly.	3	3	3	3	3
N	1790839	2223755	1663738	1656640	1916570

Notes: This table presents the results of a regression discontinuity design on variables indicating access to publicly funded subsidies to private higher education. The final sample includes all students taking the ENEM exam between 2014 and 2015 who are expected to graduate from high school in that same year and who obtained a grade higher than zero on ENEM's essay—2,876,864 students total. In each column, we test whether crossing the eligibility threshold has a significant impact for a given type of subsidy. In column (1) we test the impact on all subsidies available, in column (2) on subsidized credit (FIES), in column (3) on any scholarship (PROUNI), in column (4) on full scholarship and in column (5) on partial scholarship. We implement a data driven non parametric version of the RD design and select optimal bandwidths according to a MSE selection procedure (Calonico et al., 2015). We assess the robustness of our results using local polynomial estimators of various orders. Row *Coeff.* presents the estimate of treatment effect, row *S.E.* presents standard errors, row *B.W.* presents the optimal bandwidth, row *Local-Poly.* presents the order of the local polynomial estimator and row *N* presents the number of effective observations. *** represents p-value<0.01, ** p-value<0.05, and* p-value<0.1.

Figure 5: Eligibility Effect: Access to Subsidies to Private Higher Education

(a) Subsidized Credit (FIES) (b) Scholarsips (PROUNI)



Notes: This figure presents the results of a regression discontinuity design on access to subsidized credit (FIES)—panel (a)—or publicly funded scholarship (PROUNI)—panel (b). The final sample includes all students taking the ENEM exam between 2014 and 2015 who are expected to graduate from high school in that same year and who obtained a grade higher than zero on ENEM's essay—2,876,864 students total. The x-axis represents grade on the national standardized evaluation (ENEM). In this figure, we standardize ENEM grade around the minimum threshold requirement. Thus, the grade zero represents the minimum threshold for eligibility—originally 450 points. The y-axis represents likelihood of obtaining financial aid. We implement a data driven non parametric version of the RD design and select optimal bandwidths according to a MSE optimal selection procedure (Calonico et al., 2015). For this figure, we use a linear local polynomial estimator.

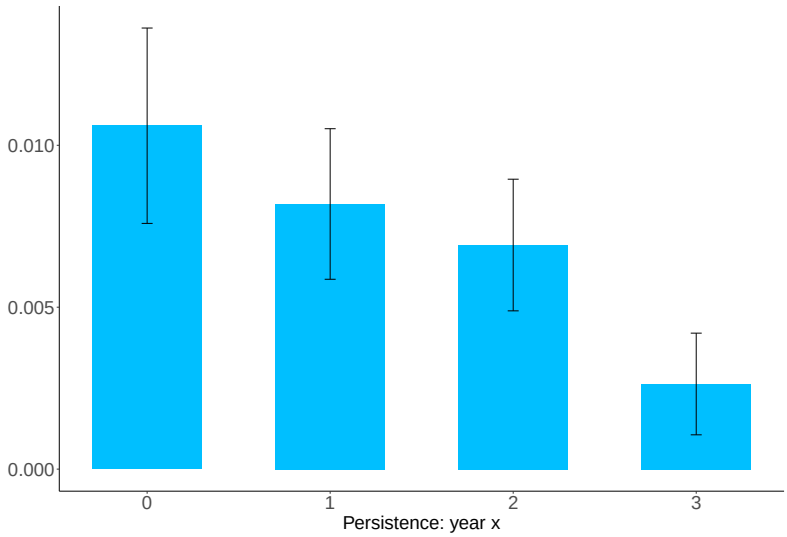
Enrollment and Persistence. Next, we estimate the impact of crossing the eligibility threshold on students' decision to enroll and persist in higher education. We implement our regression discontinuity design—as detailed in section 4—on variables indicating if the student enrolled in higher education the year after taking the ENEM exam and if the student remained enrolled one, two, and three years after initial enrollment. We have students' enrollment information for every higher education institution in the country. Thus, we are able to identify the educational decisions of every student who is part of our final sample. In our preferred specification, we implement a data driven regression

discontinuity design estimating a local linear regression around the eligibility threshold and selecting optimal bandwidths according to a mean square error (MSE) optimal selection procedure (Calonico et al., 2015). Later in this section, we show that our results are not sensitive to our choice of specification. Figure 6 presents the results of our analysis. Obtaining the minimum grade required for eligibility for financial aid has a positive and significant impact on students' likelihood of enrolling in higher education. Students who cross the eligibility threshold are one percentage point more likely to enroll in higher education. Considering that students just below the eligibility threshold have a 10% probability of enrolling in higher education, eligibility increases enrollment by approximately 10%. Figure 6 also shows that the impact of eligibility on the likelihood of persisting up to three years after initial enrollment is positive and significant. The likelihood of persisting one, two, and three[41] years after initial enrollment increases by 0.8, 0.6 and 0.2 percentage points. This decreasing impact with time is consistent with the high dropout rates in the country.[42] Comparing our results with the average persistence for students just below the threshold reveals that eligibility for financial aid increases persistence by almost 10% for every year after initial enrollment—8% after the first year, 10% after the second year, and 11% after the third year. One concern with a policy that subsidizes access to higher education through tuition payments is that students may lack the academic readiness or the financial means to cover for non-tuition costs required for persistence. Our result suggests that low-ability students who enroll in higher education due to being eligible to financial aid present the same likelihood of persisting after enrollment as students in the full sample.

[41] As detailed in section 3, we only have information on students persistence at the end of the third year for the students who took the ENEM exam in 2014—roughly half of our sample.

[42] In Brazil, only 33% of students graduate with a bachelor's degree within the expected duration of the program (OECD, 2019).

Figure 6: Eligibility Effect: Persistence by end of year x

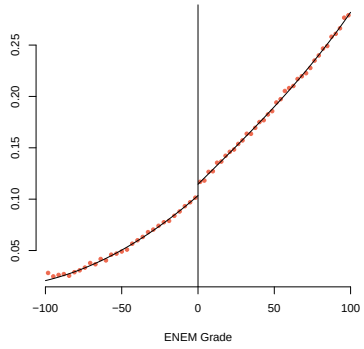


Notes: This figure presents the results of a regression discontinuity design on enrollment after x years. The final sample includes all students taking the ENEM exam between 2014 and 2015 who are expected to graduate from high school in that same year and who obtained a grade higher than zero on ENEM's essay—2,876,864 students total. The x-axis represents years after initial enrollment. The y-axis represents treatment effect x years after initial enrollment. We implement a data driven non parametric version of the RD design and select optimal bandwidths according to a MSE optimal selection procedure (Calonico et al., 2015). For this figure, we use a linear local polynomial estimator.

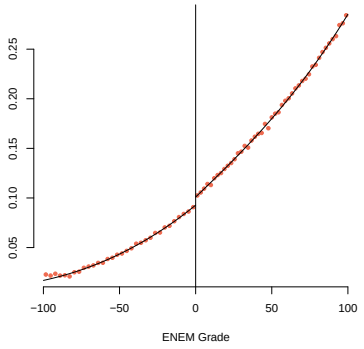
Figure 7 illustrates the relation between ENEM grade and enrollment and attainment around the eligibility threshold. As expected, both enrollment and persistence are increasing with ENEM grade, i.e. higher ability students—as measured by grade in the national standardized evaluation for high school students—are more likely to enroll and persist in higher education. Figure 7 also illustrates the impact of crossing the eligibility threshold on students' behavior, i.e., the positive impact of crossing the eligibility threshold on enrollment and attainment by the end of the first, second, and third year of enrollment.

Figure 7: Eligibility Effect: Enrollment and Persistence

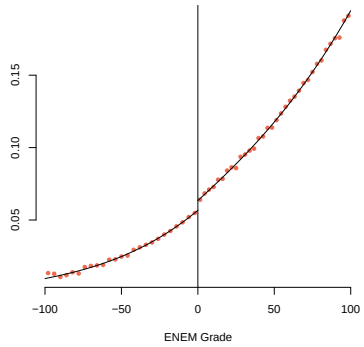
(a) Enrollment



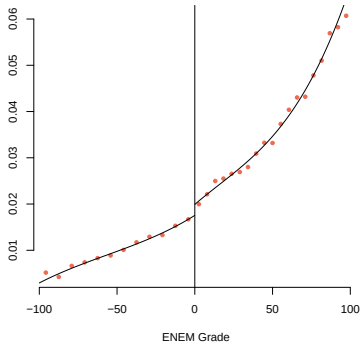
(b) Attainment by end of 1st year



(c) Attainment by end of 2nd year



(d) Attainment by end of 3rd year



Notes: This figure presents the results of a regression discontinuity design on enrollment and persistence in higher education—including public and private institutions. The final sample includes all students taking the ENEM exam between 2014 and 2015 who are expected to graduate from high school in that same year and who obtained a grade higher than zero on ENEM's essay—2,876,864 students total. The x-axis represents grade on the national standardized evaluation used to determine eligibility for subsidies to higher education (ENEM). In this figure, we standardize ENEM grade around the minimum threshold requirement. Thus, the grade zero represents the minimum threshold for eligibility—originally 450 points. The y-axis represents likelihood of enrollment (panel (a)) or persistence at the end of the first (panel (b)), second (panel (c)) or third (panel (d)) year. We implement a data driven non parametric version of the RD design and select optimal bandwidths according to a MSE optimal selection procedure (Calonico et al., 2015). For this figure, we use a linear local polynomial estimator.

Type of Institution (Public versus Private). Our data contains information on all higher education institutions in the country, including public institutions. We use these data to evaluate how eligibility for subsidized funding for private education affects students' decision to enroll in public higher education. In Brazil, public institutions are tuition-free. In general, public schools are highly selective and deemed as of higher quality and prestige. Nevertheless, there are a few reasons why students might prefer a private institution even when given the opportunity to enroll in a public one. First, admission to higher education in Brazil is determined at the major level. There is high variance on acceptance rates by major, with majors considered of high return or high prestige—such as medicine or engineering—conducting highly selective admission processes. Students—specially lower ability students—often must choose less selective majors if they want to access the subsidies offered to students enrolled in public education. Second, public institutions in the country often do not offer students the same flexibility as private schools. Full time schedules and isolated campuses restrict students' opportunities for professional training while in college.[43] Faculty and staff strikes are common and students sometimes are not able to precisely predict graduation dates. Public institutions are also often criticized for their inability to adapt to the changing needs of the labor market (World Bank, 2017).

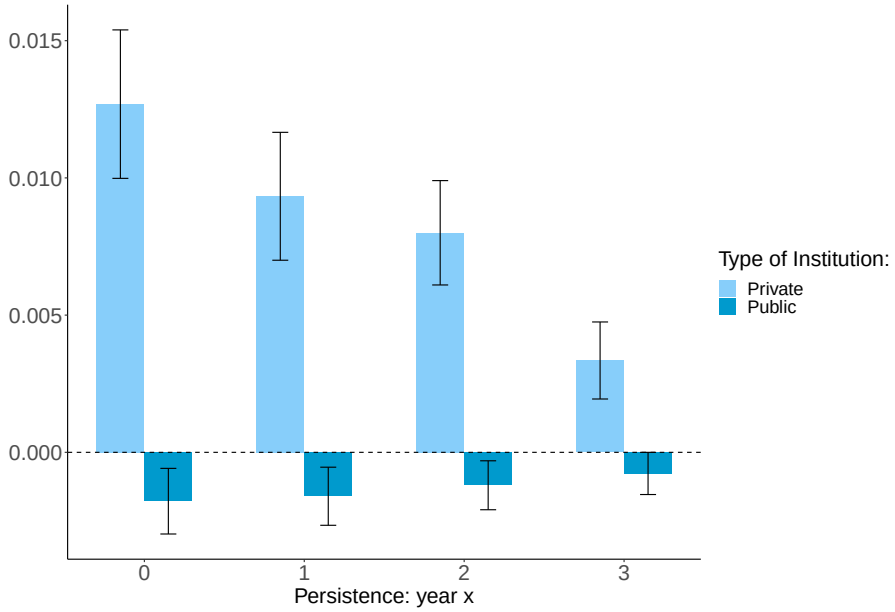
There is a literature exploring how in-kind subsidies can crowd out private spending in education and distort decisions. To access in-kind subsidies—in our framework, tuition-free public institutions—individuals must forgo investment in private education. According to Peltzman (1973), the in-kind nature of this type of subsidy can encourage students to reduce their total investment in education—in terms of quantity or quality. According to this literature, even students who believe private schools are a better fit for them, would be discourage from applying to private schools given the in-kind nature of subsidies for public schools. Students could benefit from a system that gives them the opportunity to choose how to apply subsidies for education by choosing a program that is a better match for their needs or preferences. This system could also encourage competition between higher education institutions increasing the quality of public provision (Long, 2006).

Our setting gives us the opportunity to explore how students react when they are given the opportunity to choose how to apply subsidies between public or private institutions. Students in our sample who obtain the minimum academic performance required for access to financial aid are eligible for subsidies for private higher education. Some of

[43] Most internship opportunities in Brazil are year round, with students usually taking a period of the day off from school for professional training.

these students may also qualify for public tuition-free higher education. Exploring the impact of crossing the eligibility threshold on the decision to enroll and persist in public and private institutions shed a light on how in-kind subsidies can impact behavior. Figure 8 presents the results of this exercise. Figure 8 shows that there is a positive and significant impact of crossing the eligibility threshold on enrollment and persistence in private higher education and a negative and significant impact on enrollment and persistence in public higher education. For students that cross the eligibility threshold, the likelihood of enrolling in private higher education increases 8.5% from the sample average and the likelihood of enrolling in public higher education decrease 3% from the sample average. Our results show that students reduce their demand for public tuition-free institutions when given the opportunity to apply at least part of the subsidies they would obtain from public education into private schools, an outcome consistent with the predictions of the Peltzman's model.

Figure 8: Eligibility Effect: Persistence year x



Notes: This figure presents the results of a regression discontinuity design on enrollment after x years on public and private institutions. The final sample includes all students taking the ENEM exam between 2014 and 2015 who are expected to graduate from high school in that same year and who obtained a grade higher than zero on ENEM's essay—2,876,864 students total. The x-axis represents years after initial enrollment. The y-axis represents treatment effect x years after initial enrollment. We implement a data driven non parametric version of the RD design and select optimal bandwidths according to a MSE optimal selection procedure (Calonico et al., 2015). For this figure, we use a linear local polynomial estimator.

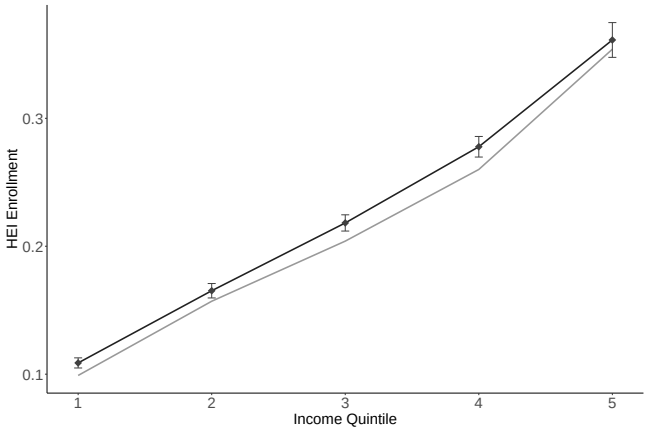
Heterogeneity by Students' Income. Our detailed data and large sample size gives us the opportunity to explore how income impact students' response to subsidy eligibility. As detailed in section 3, we have access to a self reported categorical variable that indicates the students' family income in terms of different ranges of minimum wages. We use this variable to build an approximate measure of per capita family income. We then use the per capita family income variable to split the sample into different income quintiles. Estimating the eligibility impact for students in different quintiles shows how response to subsidies for private higher education varies with students' income. Figure 9 illustrates the likelihood of enrolling in higher education for students from different income quintiles—the gray line—and the differential eligibility impact—the black line. We find that the likelihood of enrolling in higher education is increasing with income. In our sam-

ple, students from the highest income quintile are 3.7 times more likely to enroll in higher education—at a 35% rate—than students in the lowest income quintile. We also find that the eligibility effect is increasing with income. The eligibility effect is positive and significant for all income quintiles except for the highest one and it is stronger for higher quintiles. We thus find that students with higher family income react more strongly to subsidy eligibility up to the income level in which students are unlikely to qualify for subsidies—the highest income level. Table 6 further details these results.

A policy that reduces or eliminates credit constraints is expected to have a stronger impact on students more likely to be constrained, i.e., lower income students (Solis, 2017). In our case, the relation between income and eligibility effect is more complex for at least two reasons. First, the government is not only relaxing income constraints, but also subsidizing access to higher education. In appendix section A we develop a model that illustrates how subsidies for higher education alter relative prices and the expected net returns from education. If higher income individuals are more likely to be closer to the indifference curve between enrolling or not in higher education, they will be more strongly affected by subsidy eligibility. Second, subsidies are distributed according to students performance in the national evaluation of high school students. If performance is positively correlated with income—which is true in our framework—distributing subsidies according to academic performance tends to benefit higher income students.

Our results highlight how the design of the subsidy distribution policy can determine its impact for students from different income levels. Both FIES and PROUNI are not available for students whose family income crosses a given threshold. This design restricts access to subsidies for students at the higher end of the national income distribution. But there is still an income distribution of potential beneficiaries—students whose family income sits below the threshold. A policy that determines subsidy allocation based on academic performance and it is blind to other socioeconomic characteristics is likely to distribute larger subsidies to students in the top of the income distribution of potential beneficiaries. Our empirical exercise suggests that this is the case. According to our results, policies that intend to prioritize students in the very lower end of the income distribution must consider income as a relevant factor for the allocation of benefits.

Figure 9: Eligibility Effect: Enrollment by Income Quintile



Notes: This figure presents the results of a regression discontinuity design on the enrollment of students with different income levels. We use the per capita income variable—generated as detailed in section 3—to split the final sample into different income quintiles. We then estimate a regression discontinuity for each income quintile. The x-axis represents income quintiles, with 1 representing the lowest and 5 the highest. The y-axis represents likelihood of enrollment. The gray line represents the average likelihood of enrollment for students in each income quintile. The black line represents the treatment effect—the impact of eligibility for financial aid on enrollment. Confidence intervals are given by the vertical lines. We implement a data driven non parametric version of the RD design and select optimal bandwidths according to a MSE optimal selection procedure (Calonico et al., 2015). For this figure, we use a linear local polynomial estimator.

Table 6: Eligibility Effect: Enrollment by Income Quintile

Income Quintile	(1) Higher Education
Lowest	0.0098 ***
	(0.002018)
Second	0.008224 ***
	(0.002877)
Third	0.014217 ***
	(0.003239)
Fourth	0.017762 ***
	(0.004105)
Highest Fifth	0.007224
	(0.006933)

Notes: This table presents the results of a regression discontinuity design on variables indicating enrollment of students from different income levels. We use the per capita income variable—generated as detailed in section 3—to split the final sample into different income quintiles. We then estimate a regression discontinuity for each income quintile. Each row presents results for a different income quintile, as given by first column labels. In each column, we test whether crossing the eligibility threshold has a significant impact on enrollment. Standard errors are presented in parenthesis. We implement a data driven non parametric version of the RD design and select optimal bandwidths according to a MSE selection procedure (Calonico et al., 2015). For this table, we use a linear local polynomial estimator. *** represents p-value<0.01, ** p-value<0.05, and* p-value<0.1.

Heterogeneity by Students' Race. Racial disparities in socioeconomic status and access to higher education are widespread in Brazil. Even though blacks comprise almost 10% of the country's population[44], they represented only 7.8% of students newly enrolled in public higher education and 5.02% of students newly enrolled in private higher education in 2015.[45] An analysis of the socioeconomic background of students enrolling in higher education with FIES and PROUNI shows that the share of black students enrolled with both programs is similar—around 7 percent—and higher than the average share of black students enrolled in private higher education as a whole. For PROUNI, this result is not

[44]PNAD Contínua 2019

[45]For information on recent progress and the country's affirmative action policies see Francis and Tannuri-Pianto (2012), Francis-Tan and Tannuri-Pianto (2018), Estevan et al. (ming), and Mello (2019)

surprising. PROUNI explicitly reserves a share of its scholarships to students from underrepresented minorities. FIES, on the other hand, does not consider race as a relevant factor for the distribution of funding. The high number of black students enrolling in higher education with FIES suggests that these students might be more sensitive to the availability of subsidies when deciding to enroll in higher education. We can use our detailed data set to explore if black students react differently to being considered eligible for subsidies.

To evaluate the impact of eligibility for subsidies on black students, we replicate our previous empirical analysis splitting the sample between black and non black students. Table 7 presents the results of this exercise. We find that the impact of subsidy eligibility on black students is much stronger than the impact on non black students. Specifically, we find that black students are more than two times more likely to enroll in higher education is response to subsidy eligibility than non black students. We also find no impact on enrollment in public higher education, suggesting that the negative impact on enrollment in public higher education we find for the full sample is driven by the behavior of non black students. We cannot affirm with certainty if this result reflects the impact of PROUNI's affirmative action arm or if it is consequence of a higher sensitivity of black students to aid eligibility. Nevertheless, as we will argue later in this section, we have reason to believe that the impact of eligibility on students' decision to enroll in private higher education is driven mainly by FIES. In this case, our result could be considered evidence of a higher sensitivity of black students.

Table 7: Eligibility Effect: Enrollment of Black Students

Student Char	(1) Higher Education	(2) Private H.E.	(3) Public H.E.
Non Black Students	0.009 ***	0.011 ***	-0.002 ***
	(0.002)	(0.001)	(0.0006)
Black Students	0.020 ***	0.020 ***	-0.0007
	(0.004)	(0.003)	(0.001)

Notes: This table presents the results of a regression discontinuity design on variables indicating enrollment of black and non black students. We use information from the ENEM survey to split the final sample into black and non black students. We then estimate a regression discontinuity for each different set of students. The first two rows present results for non black students. The final two rows present results for black students. In each column, we test whether crossing the eligibility threshold has a significant impact on enrollment. Standard errors are presented in parenthesis. We implement a data driven non parametric version of the RD design and select optimal bandwidths according to a MSE selection procedure (Calonico et al., 2015). For this table, we use a linear local polynomial estimator. *** represents p-value<0.01, ** p-value<0.05, and* p-value<0.1.

Our analysis on the presence of income heterogeneities in treatment effect reveals that the eligibility impact is increasing with income up to the income level in which students are no longer eligible for subsidies. We argue that this result suggests that a policy that distributes subsidies according to students' academic performance in a framework in which family income and academic readiness are positively correlated is likely to have a stronger impact on students in the higher end of the income distribution of potential participants. We then suggest that a policy intending to prioritize lower income individuals must consider income in their benefit allocation rule. One might wonder what would be the impact of explicitly considering a socioeconomic characteristic highly correlated with income. In our framework, one such characteristics is students' race. In our sample of ENEM takers, black students are over-represented among lower income students—27% of black students are in the lowest income quintile and 25% of black students are in the second lowest income quintile. To explore what would be the impact of targeting black students, we evaluate whether the impact of subsidy eligibility is heterogeneous across income levels when we consider only the sample of black students. Table 8 presents the results of this exercise. Our results show that the eligibility impact is also increasing with income for the

sample of only black students. This result further highlights the importance of policy design for the allocation of subsidies. Not considering income as a factor in the distribution of subsidies to students benefits students in the higher end of the income distribution of eligible students even when we target a population that is over represented among lower income students.

Table 8: Eligibility Effect: Enrollment by Income Quintile and Race

	(1)	(2)
Income Quintile	Non-Black Students	Black Students
Lowest	0.0087 ***	0.0166 ***
	(0.0022)	(0.0059)
Second	0.0062 *	0.0223 ***
	(0.0032)	(0.0064)
Third	0.0135 ***	0.0208 **
	(0.0034)	(0.0086)
Fourth	0.0153 ***	0.0361 ***
	(0.0045)	(0.0118)
Highest Fifth	0.0068	0.0191
	(0.0072)	(0.0216)

Notes: This table presents the results of a regression discontinuity design on variables indicating enrollment of black and non black students from different income levels. We use the per capita income variable—generated as detailed in section 3—to split the final sample into different income quintiles and split this sample among black and non black students. We then estimate a regression discontinuity for each income quintile and race. Each row presents results for a different income quintile, as given by first column labels. In each column, we test whether crossing the eligibility threshold has a significant impact on enrollment. Standard errors are presented in parenthesis. I column (1), we estimate the impact on non black students and in column (2) the impact on black students. We implement a data driven non parametric version of the RD design and select optimal bandwidths according to a MSE selection procedure (Calonico et al., 2015). For this table, we use a linear local polynomial estimator. *** represents p-value<0.01, ** p-value<0.05, and* p-value<0.1.

Quality at the Major-Institution Level. Enrollment and persistence are just one attribute

of choice. When deciding how much to invest in higher education, students also choose quality. Our framework allows us to explore how eligibility for financial aid impact students' choice between programs of different quality. As in Londoño-Vélez et al. (2020), we restrict this analysis to the students who actually enrolled in higher education. The availability of financial aid can impact students investment in quality in non-trivial ways. On one hand, subsidies can reduce the costs associated with higher quality programs allowing students from an underprivileged background to access these programs. On the other, when the supply of aid is constrained—as in our case—students can strategically alter their quality investment decisions to increase their likelihood of obtaining subsidies. We explore how eligibility for financial aid impact students' decision to invest in quality both at the major-institution and at the institution level.

We measure quality through variables that indicate the academic readiness of previous cohorts[46], the selectivity of the program, the proportion of students who do not persist, the qualifications of the teaching staff, and the proportion of online classes. Table 9 presents the impact of being considered eligible for subsidies on quality at the major-institution level. We find that eligibility impacts only two quality variables at the program level, the proportion of full time faculty and the number of applicants per maximum cohort size. Given that eligibility has a negative impact on enrollment in public institutions, the negative impact on full time faculty is not surprising. Public institutions in Brazil are significantly more likely to hire teaching staff as full time faculty. The fact that we explore the impact of aid on students around the eligibility threshold helps explain the negative impact on number of applicants per cohort size. As detailed in section 2, for both FIES and PROUNI aid is distributed according to students' ENEM performance. As such, students who just crossed the eligibility are unlikely to qualify for aid on programs with low admission rates. The fact that this impact on selectivity is not consistent with the impact on other quality indicators suggests that eligibility for aid does not consistently impact students investment in quality at the program level.

[46]The variable *Average ENEM Grade* and *Minimum ENEM Grade* measure the average and minimum ENEM grade of freshman students from the previous cohorts

Table 9: Eligibility Effect: Major-Institution Level Characteristics

Variables	(1) Linear	(2) Linear (Robust)	(3) Quadratic	(4) Quadratic (Robust)
Average ENEM Grade	0.145	0.366	0.396	0.539
	(0.683)	(0.788)	(0.827)	(0.920)
Minimum ENEM Grade	0.0213	0.125	0.064	0.034
	(0.829)	(0.971)	(0.987)	(1.083)
Applicants per Max. Cohort Size	-0.272 ***	-0.278 ***	-0.279 ***	-0.290 ***
	(0.057)	(0.068)	(0.070)	(0.078)
Dropout Rate	0.009	0.008	0.007	0.006
	(0.009)	(0.011)	(0.011)	(0.012)
On leave Rate	-0.002	-0.002	-0.002	-0.002
	(0.003)	(0.003)	(0.003)	(0.003)
Faculty with PhD (proportion)	0.000	-0.000	-0.001	-0.001
	(0.003)	(0.003)	(0.004)	(0.004)
Full Time Faculty (proportion)	-0.017 ***	-0.019 ***	-0.019 ***	-0.020 ***
	(0.003)	(0.004)	(0.004)	(0.004)
Distance Courses (proportion)	0.233 *	0.224	0.226	0.223
	(0.126)	(0.149)	(0.150)	(0.167)

Notes: This table presents the results of a regression discontinuity design on quality at the major-institution level. The sample includes all students in the original sample that enrolled in higher educatio after taking the ENEM exam—610,137 students total. In each row, we test whether crossing the eligibility threshold has a significant impact on a given major-institution characteristic. Variables names are presented in the first column. We implement a data driven non parametric version of the RD design (Calonico et al., 2015). Across columns we assess the robustness of our results using local polynomial estimators of various orders—columns (1) and (2) linear and columns (3) and (4) quadratic—and implementing a bias-corrected robust inference procedure (Calonico et al., 2014)—columns (2) and (4). *** represents p-value<0.01, ** p-value<0.05, and* p-value<0.1.

Quality at the Institution Level. Table 10 presents the impact of crossing the eligibility threshold on quality at the institution level and tells a different story. According to table 10, students eligible for financial aid are more likely to enroll in institutions with lower academic readiness from the previous cohort, lower number of applicants per maximum cohort size and higher dropout rates. Results, thus, suggest that, even though eligibility for financial aid does not affect quality investment at the program level, it has a negative impact on quality at the institution level. This result is consistent with a frame-

work in which students choose less selective institutions—for instance private over public schools—to qualify for financial aid to programs they believe are a better fit for their needs.

Table 10: Eligibility Effect: Institution Level Characteristics

Variables	(1) Linear	(2) Linear (Robust)	(3) Quadratic	(4) Quadratic (Robust)
Revenue per Student	6397.640 *	7047.910 *	6769.186	6737.135
	(3616.159)	(4283.509)	(4415.925)	(4799.308)
Tuition Revenue - per Student	5875.427 *	6550.148	6623.224 *	6689.125
	(3415.614)	(4078.344)	(3895.996)	(4246.479)
Average ENEM Grade	-1.479 ***	-1.597 **	-1.634 **	-1.724 **
	(0.574)	(0.671)	(0.662)	(0.737)
Minimum ENEM Grade	-1.057 ***	-1.072 ***	-1.169 **	-1.251 **
	(0.346)	(0.406)	(0.462)	(0.517)
Applicants per Max. Cohort Size	-0.290 ***	-0.306 ***	-0.305 ***	-0.317 ***
	(0.059)	(0.068)	(0.067)	(0.074)
Dropout Rate	0.003 *	0.004 *	0.004 **	0.005 **
	(0.002)	(0.002)	(0.002)	(0.002)
On leave Rate	0.003	0.003	0.003	0.003
	(0.002)	(0.003)	(0.003)	(0.003)

Notes: This table presents the results of a regression discontinuity design on quality at the institution level. The sample includes all students in the original sample that enrolled in higher education after taking the ENEM exam—610,137 students total. In each row, we test whether crossing the eligibility threshold has a significant impact on a given institution characteristic. Variables names are presented in the first column. We implement a data driven non parametric version of the RD design (Calonico et al., 2015). Across columns we assess the robustness of our results using local polynomial estimators of various orders—columns (1) and (2) linear and columns (3) and (4) quadratic—and implementing a bias-corrected robust inference procedure (Calonico et al., 2014)—columns (2) and (4). *** represents p-value<0.01, ** p-value<0.05, and* p-value<0.1.

Major Choice. It is not clear how the decision to enroll in programs of equivalent quality offered by lower quality institutions impacts students' skill formation while in college and their expected outcomes in the labor market. The literature shows that prestige at the institution level impacts labor market outcomes (MacLeod and Urquiola (2015), MacLeod et al. (2017)). It also shows that investment decisions at the program level, for instance choice of major, impact returns to education (Arcidiacono (2004), Hastings et al. (2013)).

To investigate if eligibility for aid impacts students' choice between different majors, we replicate our regression discontinuity design—as detailed in section 4—on variables indicating if the student enrolled in a particular major. Table 11 presents the results of this exercise. For all specifications considered, eligibility for aid has a positive and significant impact on the likelihood of students choosing three majors: Engineering, Agricultural Sciences and General Health.[47] As detailed in Duarte (2020), the tuition costs of these majors are higher than average and both Engineering and Agricultural Sciences majors offer higher than average labor market returns for young and older professionals. These three majors also offer specific market-oriented training and a more straightforward path for a profession. Results, thus, suggests that, in a framework in which students choose major during the application process, students eligible for financial aid tend to prioritize technical majors with higher costs and return over institution's prestige.

[47] General Health includes all health majors except for Medicine and Odontology.

Table 11: Eligibility Effect: Major Choice

Variables	(1) Linear	(2) Linear (Robust)	(3) Quadratic	(4) Quadratic (Robust)
Education	0.001	0.001	0.001	0.001
	(0.001)	(0.001)	(0.001)	(0.001)
Humanities and Arts	-0.000	-0.000	-0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)
Social Sciences and Business	0.002 **	0.001 *	0.001	0.001
	(0.001)	(0.001)	(0.001)	(0.001)
Science, Math and Comp.	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)
Law	0.001	0.000	0.000	0.000
	(0.000)	(0.001)	(0.001)	(0.001)
Engineering	0.002 ***	0.002 ***	0.002 ***	0.002 ***
	(0.001)	(0.001)	(0.001)	(0.001)
Agricultural Sciences	0.001 **	0.001 **	0.001 **	0.001 **
	(0.000)	(0.000)	(0.000)	(0.000)
Health (General)	0.004 ***	0.004 ***	0.004 ***	0.004 ***
	(0.001)	(0.001)	(0.001)	(0.001)
Health (Medicine)	-0.000	-0.000	-0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)
Health (Odontology)	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)
Others	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)

Notes: This table presents the results of a regression discontinuity design on students choice of major. The final sample includes all students taking the ENEM exam between 2014 and 2015 who are expected to graduate from high school in that same year and who obtained a grade higher than zero on ENEM's essay—2,876,864 students total. In each row, we test whether crossing the eligibility threshold has a significant impact on the choice of enrolling in a given major. Major names are presented in the first column. We implement a data driven non parametric version of the RD design (Calonico et al., 2015). Across columns we assess the robustness of our results using local polynomial estimators of various orders—columns (1) and (2) linear and columns (3) and (4) quadratic—and implementing a bias-corrected robust inference procedure (Calonico et al., 2014)—columns (2) and (4). *** represents p-value<0.01, ** p-value<0.05, and* p-value<0.1.

Discussion: FIES or PROUNI. In all the results presented so far, we evaluated the

impact of eligibility for subsidies for higher education making no distinction between the federal credit—FIES—and the federal scholarship program—PROUNI. We adopt this strategy, because both programs consider the same academic readiness threshold for eligibility and we are not able to separately identify the impact of each program around the eligibility threshold. As we detail in section 2, there are significant differences between the two programs and it is important to understand by how much each program drives our results. Our empirical design does not allow us to answer this question with certainty, but we can use the available data and the differences in design between the two programs to shed some clarity on this point.

We start by evaluating the likelihood of obtaining subsidies from both PROUNI and FIES for those students most likely to be affected by the minimum academic ability requirement, i.e. students with academic performance within a certain range of the eligibility threshold. We use our data to identify the share of students around the eligibility threshold that enroll in higher education with PROUNI or FIES. Table 12 presents the proportion of students within a given range of the eligibility threshold that enroll in private higher education and the proportion that enroll with FIES or PROUNI. Results reveal that for the sample of students most likely to be affected by the eligibility threshold, FIES is a much more relevant source of subsidies for higher education. Of the students with ENEM grade within 25 points of the eligibility threshold—i.e. students whit grades higher than 425 and lower than 475—23% of those who enrolled in private higher education enrolled with FIES, while only 4% enrolled with PROUNI. When we increase the range around the threshold the proportion of students enrolling with PROUNI increases, but even for a range as high as 100 points—1.3 times the standard deviation in average grade—the proportion of students enrolling in private higher education with FIES—26%—is significantly higher than the proportion enrolling with PROUNI—9%.

This results is not surprising. As detailed in section 2, PROUNI is a much more generous program from the students' perspective. As such, demand for PROUNI is stronger among students eligible for both programs and students enrolling in higher education with PROUNI tend to perform better at ENEM than students enrolling with FIES. Since the eligibility threshold represents a value in the lower end of ENEM grade distribution, it is unlikely that students whose ENEM performance is around this threshold would qualify for a large number of PROUNI scholarships. This results suggests that FIES is a more relevant program for the students in our analysis and that most of our findings are driven by the decisions and behavior of students enrolling in higher education with FIES.

Table 12: Descriptive Statistics: Students' Choice Around the Eligibility Threshold

Variable	(1) [-25, +25]	(2) [-50, +50]	(3) [-75, +75]	(4) [-100, +100]
Proportion that Enroll in Private H.E.	0.099	0.107	0.116	0.126
Proportion that Enroll with FIES	0.023	0.026	0.030	0.033
Proportion that Enroll with PROUNI	0.004	0.005	0.008	0.012
Observations	676,908	1,276,294	1,742,644	2,076,845

Notes: This table presents descriptive information on students' choice for students who obtained a ENEM grade within a given range from the eligibility threshold. In the first row, we present the proportion of students that enroll in private higher education. In the second row, proportion of students that enroll in private higher education with FIES funding, and in the third row, proportion of students that enroll in private higher education with a PROUNI scholarship. Different ranges from the eligibility threshold are presented in each column. In column (1), we have students who obtained a grade less than 25 points higher or lower than the eligibility threshold grade—450. In column (2), we have students who obtained a grade 50 points higher or lower. In column (3) students who obtained a grade 75 points higher or lower, and, finally in column (4) students who obtained a grade 100 points higher or lower than the eligibility threshold.

To further evaluate how reasonable this conclusion is, we perform one extra exercise that capitalize on the differences between FIES and PROUNI's rules. As detailed in section 2, PROUNI is more restrictive in terms of what type of students can be considered eligible for the program. In particular, only students who graduated from a public high school or from a private high school with full scholarship can apply for PROUNI.[48] From ENEM data, we can observe which students graduated from public and which students graduated from private schools. We use this information and replicate our empirical design considering two separate samples, one only with students who graduated from public high schools and the other considering only students who graduated from private high schools. Table 13 presents the results from this exercise. According to these results, the eligibility effect on enrollment in private higher education for students eligible for PROUNI and FIES—students who graduated from public high schools—is very similar to the eligibility effect on students only eligible for FIES. Specifically, students who graduated from

[48]We do not consider separately students graduating from private schools with full scholarship because they represent a very small share of students in our data—less than 3%—and because these students are usually in the higher end of the ability distribution.

a public high school are only 9% more likely to enroll in private higher education in response to crossing the academic eligibility threshold for PROUNI and FIES than students graduating from private high schools. These results suggest that the main driver for results that measure the eligibility effect on students decision to enroll in private higher education is students' reaction to FIES eligibility.

Effects are different for these two groups of students when we consider enrollment in public higher education as the output variable. The negative eligibility effect on enrollment in public higher education is concentrated among students who graduated from public high schools. Considering that students who graduated from public high schools are eligible to both PROUNI and FIES, we cannot separately identify the impact of these two programs for decisions related to enrollment in public institutions.

Table 13: Eligibility Effect: Students Graduating from Public or Private High Schools

	(1)	(2)	(3)
Student Characteristic	Higher Education	Private H.E.	Public H.E.
Graduates from Public High Schools	0.0113 ***	0.0130 ***	-0.0021 ***
	(0.0014)	(0.0014)	(0.0007)
Graduates from Private High Schools	0.0123 **	0.0119 **	0.0000
	(0.0060)	(0.0060)	(0.0015)

Notes: This table presents the results of a regression discontinuity design on variables indicating enrollment of students who graduated from public and private high schools. We use information from the ENEM survey to split the final sample into students who graduated from public and private high schools. We then estimate a regression discontinuity for each different set of students. The first two rows present results for students who graduated from public high schools. The final two rows present results for students who graduated from private high schools. In each column, we test whether crossing the eligibility threshold has a significant impact on enrollment. Standard errors are presented in parenthesis. We implement a data driven non parametric version of the RD design and select optimal bandwidths according to a MSE selection procedure (Calonico et al., 2015). For this table, we use a linear local polynomial estimator. *** represents p-value<0.01, ** p-value<0.05, and* p-value<0.1.

Robustness Analysis. For all results presented in this section, we estimate treatment effect using a data driven non parametric regression discontinuity design. In our preferred specification, we estimate a local linear regression on a small neighborhood around

the minimum eligibility threshold. We determine this neighborhood by employing a mean square error (MSE) optimal bandwidth selection procedure as developed by Calonico et al. (2015). One of the main weaknesses of an RD design is that choice of specification can have a significant influence on results. We assess the robustness of our results replicating the analysis considering higher order local polynomial estimators and implementing a bias-corrected robust inference procedure (Calonico et al., 2014)). Tables B.1, B.2, B.3, and B.4 in section B detail this exercise and show that our results are significantly robust to different choices of specification. The estimates on the impact on enrollment and persistence up to two years remain stable across all different specifications. Results on the impact on persistence after three years are stable for all specifications except one—results are sensitive to estimating a cubic local regression. Considering that we only observe persistence after three years for students who took the ENEM exam in 2014—roughly half of our sample—it is not surprising that we are not able to estimate the impact on this variable with the same confidence we have for other variables for more restrictive specifications.

Given our large sample size and the fact that our eligibility threshold is defined at a number multiple of 10, one might worry that our estimates represent some sort of round number bias unrelated to financial aid eligibility. To investigate if this is the case, we perform a placebo exercise. We define a set of placebo thresholds[49] and test the impact of crossing these thresholds on enrollment. Tables B.5, B.6, B.7 in section B present the results of this exercise. For all placebo thresholds except one—500—we find no significant impact on enrollment. Even in the case we find a significant impact, the estimates are not stable across specifications. These findings corroborate the robustness of our results.

6 Discussion

In this paper, we exploit discontinuities in access to subsidies for private higher education to investigate how eligibility for financial aid impact students' human capital investment decisions. We find that eligibility for financial aid has a positive and significant impact on students' likelihood to enroll in higher education and to persist up to three years after initial enrollment. We also conclude that the availability of subsidies for private education reduce students' enrollment in public tuition-free institutions, a finding consistent with the predictions of Peltzman (1973). Exploring heterogeneities by students' background, we show that response to subsidies is increasing with income up to the income level in

[49] We consider the following placebo thresholds: 455, 460, 475, 500, 525, 550, 600, and 700

which students are not eligible for aid. This is consistent with the model we present in section A and with the allocation policy of the programs we evaluate. We also find that the eligibility effects is stronger for black students and that treatment effect is increasing with income also for the sample of only black students. Our results show that eligibility for financial aid does not influence investment in quality at the major level but decrease investment in quality at the institution level. Finally, we show that students eligible for aid are more likely to choose technical majors with higher than average labor market returns. In this section, we discuss these findings.

Our results suggests that there are inefficiencies in the distributions of subsidies for higher education in Brazil. Event though public institutions in Brazil play a leading role in funding and stimulating research[50], not much evidence is available on the relative effectiveness of teaching at public institutions in Brazil. Students graduating from public institutions tend to outperform their peers on Brazil's national evaluation for graduating students (ENADE), but there is no evidence that public institutions in Brazil add more value and this performance difference does not necessarily holds once you control for the ability differential of incoming students (World Bank, 2017). Public institutions also seem slower to adapt to students and labor market changing needs. Between 2010 and 2017, there was a relatively homogeneous increase on the size of incoming cohorts by different fields of knowledge at public institution—between 32% and 55%. For private institutions, the increase on the size of incoming cohorts was heterogeneous across fields. For higher cost or return fields, the size of incoming cohort almost doubled—an increase of 145% for health, 197% for agricultural sciences, and 254% for engineering. For other fields, like humanities, education, and social sciences the income cohort increased by much less—between 45% and 88%. More research is needed to understand the role public institutions play in contributing with skill formation in Brazil and how to increase their effectiveness.

One of the concerns raised on policies that subsidize access to private education is that they might encourage enrollment in low-quality institutions that do not adequately prepare students to succeed in the labor market. Students who graduate from insufficient quality institutions might not fully access the benefits of higher education. Rau et al. (2013) find that a federal student credit program in Chile had a negative impact on the labor market wages of participants. They argue that program design incentivized institutions to retain students at the expense of quality of education. This risk might be even higher when aid is used to fund enrollment in for profit institutions. Cellini and Koedel (2017) shows

[50] According to 2017 Higher Education Census, 46% of lecturers in public institutions also worked doing research, while only 17% of lecturers in private institutions also worked as researchers.

that students graduating from for profit institutions are more likely to borrow and default and have similar or worse labor market outcomes than comparable students from public colleges. For profit institutions enroll a large share of higher education students in Brazil and this number has increased in the past few years with the growth in public subsidies for private education.[51] To minimize risks, policies must be designed to incentivize quality enhancement investments. A transparent and effective quality assurance system must also be in place.

More evidence is needed to understand the impact of Brazil's subsidy policy on labor market outcomes. In the next few years, as the affected cohorts enter the labor market, we will be able to directly evaluate the impact of these policies and their cost effectiveness. Some of the regulations in effect can help mitigate the risk that these subsidy policies will have a negative impact. Brazil has a well-established system to monitor, assess, and regulate the quality of private and public higher education institutions. This system is able to impede fraudulent or grossly unqualified institutions from entering the higher education market (OECD, 2018). Federal subsidies for private higher education are also only available to students enrolled in major-institutions that meet minimum quality requirements. Maintaining and improving the quality evaluation assessment system in Brazil as well as continuing to consider quality for eligibility seems to be important. Some alternative policies are tying the availability of subsidies to the financial outcomes of students from previous cohorts (Beyer et al., 2015)[52] or creating a system that inform students of graduation rates, salary and unemployment rates of recent graduates at the major-institution level (Hastings et al. (2015), OECD (2018)).

7 Conclusion

In this paper, we exploit a discontinuity in access to subsidies for private higher education in Brazil to investigate the impact of eligibility for subsidies on students' educational decisions. In Brazil, students must obtain a minimum grade of 450 at the national standardized evaluation for high school students to be considered eligible for subsidies for private higher education. This eligibility requirement affects students at the lower end of the ability distribution.

[51] In 2017, approximately 57% of the students enrolled in private higher education in Brazil were enrolled in a for profit institutions. In 2010, this share was of 43%.

[52] In the 2017 FIES reform the government included a risk sharing scheme in which higher education institutions would be partially responsible students' default.

Exploring the impact of eligibility on students' decision to enroll in higher education, we find that that eligibility for financial aid increases students' likelihood of enrolling in higher education by 10%. We also find that eligibility increases persistence up to three years after initial enrollment. Specifically, we find that eligibility for financial aid increases persistence by almost 10% for every year after initial enrollment—8% after the first year, 10% after the second year, and 11% after the third year.

Evaluating how eligibility for subsidies to private education impact enrollment in public tuition-free schools, we find that eligibility for subsidies for private education decrease enrollment in public higher education institutions. Peltzman (1973) argues that in-kind subsidies to education could distort students' decision and reduce productive investment in private education. Our results are consistent with Peltzman's model.

To evaluate if students' background impact their response to subsidy eligibility we test for the presence of heterogeneous impact by family income. We split our sample into five different income cohorts and estimate eligibility impact for each cohort. Our results show that eligibility effect is increasing with income up to the income level in which students are restricted from applying to financial aid. We also explore heterogeneities in the response of black students and find that the eligibility effect is stronger for black students.

Evaluating the impact of eligibility for aid on the decision to invest in quality, we find that eligibility for financial aid does not have a clear impact on quality investment at the major level. We do find a negative impact on quality investment at the institutions level. In our setting, understanding the impact of subsidies on quality is crucial. The supply of financial aid is constrained and students could, in theory, strategically choose less selective major-institutions to increase their chance of obtaining aid.

Our results are consistent with a framework in which students choose lower quality institutions to qualify for aid for enrollment in programs they consider a better match given their preferences. To investigate how aid impact choice between different programs we replicate our analysis to consider students decision between different majors.[53] Our results indicate that students eligible for aid increase their likelihood of choosing technical majors with higher than average enrollment costs or labor market returns.

[53] In Brazil, students choose major during the application process.

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Appendix

A Investment in Higher Education Model

Our empirical exercise evaluates how low-achieving students respond to eligibility for subsidies for higher education. As highlighted in Section 1, there is an extensive literature on the effects of subsidizing higher education for higher achieving students. It is less clear what is the impact of offering such subsidies to students in the lower end of the ability distribution. To understand how ability can be related to human capital investment decisions and why governments might opt to subsidize low achieving students, we develop a simple model of higher education investment based on the framework of Belley and Lochner (2007). Assume a population of $i = \{1, 2, ..., N\}$ individuals that live for two periods and are heterogeneous in ability and parental transfers. In the first period, each individual i must choose between investing in higher education or entering the labor market. We assume that the decision to invest in higher education is indivisible, i.e., individuals choose between obtaining a higher education degree or not. For simplicity, we also assume that there is no relevant heterogeneity in the investment in higher education, i.e., we opt to not consider possible quality or cost heterogeneities across institutions or majors in this paper.[54] In the second period, individuals earn wages that are a function of their ability and of their first period schooling choice.

Setting. In period $t = 0$ each individual i must make a decision, s_i, of investing or not in higher education

$$s_i = \begin{cases} 0 & \text{if } i \text{ decides not to invest in H.E.} \\ 1 & \text{if } i \text{ invests in H.E.} \end{cases}$$

Individuals differ in terms of ability and parental transfers. Individual i is endowed with a level a_i of ability[55] and a parental transfer T_i. If i decides not to invest in higher education, they enter the labor market as a low-skilled worker and receives compensation w_l. If i decides to enroll in higher education they must pay the costs associated with this investment. While enrolled in higher education, individual i must pay tuition. We also assume that individual i is not allowed to access the labor market while investing in higher

[54] For a model that considers this type of heterogeneity and studies the effect of financial-aid on major choice, see (Duarte, 2020)

[55] Here we define ability as academic ability. For a discussion on the different types of abilities and on how they impact college attendance and earnings see Prada and Urzúa (2017).

education. The cost of investing in higher education is, thus, represented by the sum of tuition and foregone wages. We assume that tuition, τ, is constant across individuals.

In our model, educational credit is available through a government program that offers loans—subsidized or not—to students who meet certain criteria.[56] In this setting, individuals eligible for the government program can cover at least part of the direct costs of higher education —tuition—borrowing, in the first period, an amount $d_i = \gamma_i \tau$ with $\gamma \in [0, 1]$. Individuals not eligible for the program have no access to credit, i.e., $\gamma_i = 0$. In the second period, students must repay their loans at an interest rate R_i. To subsidize access to higher education, the government sets R_i at a level lower than the market rate. Rules set by the government determine the size of the student loan (γ_i) and the size of the subsidy (R_i).[57] The government can offer full scholarship setting $\gamma = 1$ and $R = 0$. In period $t = 0$, consumption is given by

$$c_0 = T_i + s(\gamma_i \tau) - s\tau + (1 - s)w_l \tag{2}$$

In period $t = 1$, all individuals access the labor market. As in Belley and Lochner (2007), second period labor market returns depend on ability and on first period decision of investing or not in higher education. The compensation for high skilled workers, i.e., for workers that invested in higher education in the first period, is represented by the sum of the wage for low skilled workers, w_l, and a college premium ($w_h(a_i)$). The college premium is increasing in ability. Individuals who borrowed in the first period need to repay their loans ($R \times \gamma_i \tau$). In period $t = 1$, consumption is given by

$$c_1 = w_l + sw_h(a_i) - sR(\gamma_i \tau) \tag{3}$$

Individuals decide to invest or not in higher education solving the following optimization problem:

$$\max_{s \in \{0,1\}} \left[U(T_i + s(\gamma_i \tau) - s\tau + (1 - s)w_l) + \beta U(w_l + sw_h(a_i) - sR(\gamma_i \tau)) \right] \tag{4}$$

[56] We assume there is no private credit market for higher education. Although this is generally a strong assumption, it is one that is consistent with our empirical setting. Private credit for higher education is growing in Brazil, but still represents a significantly small share of the market. In 2017—the last year we consider in our analysis—92% of the loans for enrolled students in the country were funded through the federal government credit program.

[57] This is a reasonable assumption in our setting. As we detail in section 2, the amount of subsidies offered to students from different backgrounds are set by the government and depend on students' income and major-institution profile.

$$\text{s.t. } T_i + s(\gamma_i \tau) - s\tau + (1-s)w_l \geq 0$$

As we use the model to get qualitative predictions, we assume for simplicity that utility follows a natural logarithm function and that college premium is a linear function of ability, that is, $w_h(a_i) = w_h \times a_i$, and focus on a pictorial analysis of the model. Define $T_{min}(a_j)$ as the minimum level of parental transfer that would make an individual of ability a_j indifferent between enrolling or not in higher education. It is easy to show that $T_{min}(a_j)$ is decreasing in ability. Thus, our model establishes that ability and parental transfers act as compensating forces on the decision to enroll in higher education. Given ability, the decision to enroll in higher education is increasing in parental transfers. Alternatively, given parental transfers, the decision to enroll in higher education is increasing in ability. In this framework, high ability individuals might decide to invest in higher education even for low levels of parental transfers. Low ability individuals, alternatively, will only invest in higher education if they receive a high enough transfer from their parents.

We consider, first, a scenario with no transfers from the government ($\gamma = 0$). Figure A.1 illustrates how ability and parental transfers determine the decision to invest in higher education. In figure A.1, the x-axis represents ability—variable a—and the y-axis represents parental income–variable T. The curve represents the ability-parental transfer pairs indifferent between investing in higher education or not. The point $(1-\gamma)\tau$ in the parental transfer axis represents the model budget constraint. In a framework with no credit, the decision to invest in higher education is only available to individuals with parental transfers high enough to cover tuition costs. Areas A and B of figure A.1 determine the set of individuals for which investing in higher education is worthwhile. Individuals in area A will invest in higher education. Individuals in area B will not invest in higher education due to credit constraints. Area C represents the set of individuals for which investment in higher education is not worthwhile. Individuals in area C will not invest in higher education.

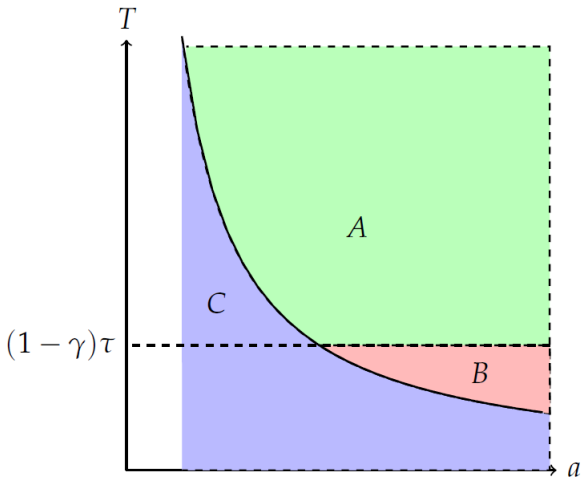

Figure A.1: Higher Education Enrollment Model

Our model can be used to illustrate how different policies for higher education impact the decision of students with different characteristics. Consider, first, a pure student credit policy. In our model, a broad student loan program capable of eliminating credit constraints could be implemented by setting the present cost of education to zero ($\gamma_i = 1$), with full repayment in the second period (R set to a market rate). Figure A.2 illustrates the impact of a pure credit policy. In this scenario, the set of individuals that find worthwhile to enroll in higher education coincides with the set of individuals that actually enroll—represented by area A. A student loan program would eliminate income-related constraints to enrollment, allowing high ability-low parental transfers individuals to access higher education (Solis, 2017). This type of policy would not affect lower ability individuals.

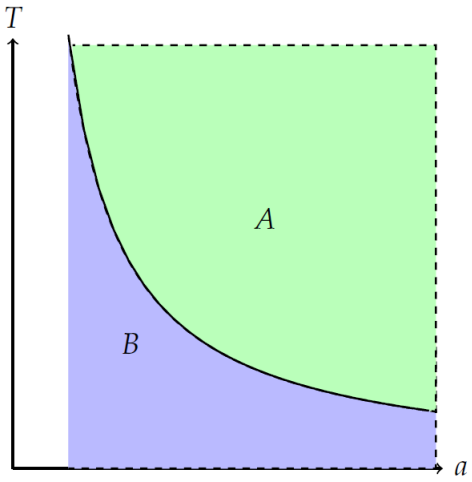

Figure A.2: Higher Education Enrollment Model - No Credit Constraints

Alternatively, the government could subsidize—fully or partially—access to higher education. In our framework, a subsidy policy could be implemented by reducing the lifetime cost of higher education (setting a positive value for γ_i and a below market rate value for R). A subsidy increases the lifetime net returns of higher education, increasing the likelihood of enrollment for individuals of all ability and parental transfer levels. The rate at which the likelihood of enrollment increases with ability and parental transfer depends on the design of the subsidy policy and on modeling assumptions. Figure A.3 represents one possible scenario. In figure A.3, we assume a policy that sets $\gamma = 1$ and R at a below market rate. This subsidy policy shifts the indifference curve inwards, increasing the likelihood of enrolling at higher education for individuals of all ability and parental transfer levels. Area A represents the set of individuals for which investment in higher education is worthwhile even with no subsidies. Area B represents the set of individuals that will invest in higher education in response to the subsidy. Area C represents individuals that will not invest in higher education.

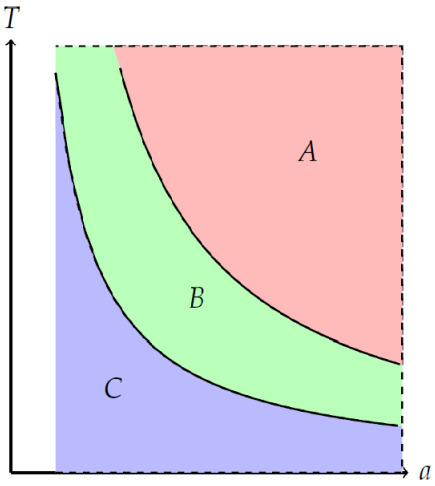

Figure A.3: Higher Education Enrollment Model - Subsidizing Higher Education

In our framework, students will invest in higher education if they believe this is an investment with net positive return. The decision of students will be made based on their best estimate of the private returns to college education by ability level and on their best estimate of their own ability. If students properly evaluate the returns to higher education, investment will be optimal conditional on the existence of a well functioning market for educational loans.[58] Thus, if students are estimating returns to higher education properly, an appropriate policy response would be to loosen credit constraints. Eliminating credit constraints impact only the decision of high-ability low-income students. There are several reasons why students from lower ability levels might be underestimating the returns to higher education.

First, it might be the case that the social return to tertiary education is higher than the private return. For instance, higher education might provide students with skills that can promote innovation and accelerate aggregate productivity and income growth (Hanushek and Woessmann (2008), Gennaioli et al. (2013)). Considering the high premiums for higher education in Brazil and elsewhere, higher education can serve as a powerful tool in reducing income inequality and promoting inter-generational mobility. It can also help reduce racial and gender gaps viewed as socially undesirable.

Second, it is possible that individuals are systematically underestimating even the pri-

[58]This is valid within our framework. In a more complex setting, students might be debt averse, might not fully observe the costs of higher education, or might not be properly informed of the available credit alternatives.

vate returns to higher education. Angel-Urdinola and Gukovas (2018) show that youth in Brazil greatly underestimate current returns to schooling. This becomes even more likely in a scenario in which technological change is expected to increase the relative returns to more complex skills, such as problem solving or critical thinking (Autor et al. (2003), Michaels et al. (2014), Acemoglu and Restrepo (2020)). Further training at the tertiary level can increase individuals' readiness to develop such skills and absorb new technologies.

Finally, it can also be the case that students underestimate their own ability. There is extensive evidence that students—specially first generation, lower income, and minority students—often underestimate their academic potential. If students cannot properly infer their academic ability, their estimates of individual returns to higher education might be imprecise (Bandura et al. (2001), Brown (2002), OECD (2015), Carlana et al. (2018), Carlana (2019), OECD (2020)).

If policy makers believe that lower ability students are likely to underestimate the returns to education, they might find worthwhile to implement policies that increase their investment in higher education. Our model informs on the need of subsidizing costs to influence the decision of students in the lower end of the ability distribution. It does not provide the information needed to obtain a quantitative estimate of the impact of these subsidies.

Our model also does not inform on the impact of such subsidies on attainment. The decision to persist after initial enrollment may depend not only on the financial, but also on the academic costs of higher education, i.e., the costs of meeting minimum academic requirements (Stinebrickner and Stinebrickner, 2012). It is reasonable to assume that academic effort is a decreasing function of ability. A policy that reduces financial costs of higher education for lower ability students, does not interfere with these academic costs. Thus it is not clear if such policy would have an impact on students' attainment. The impact of the subsidy on enrollment, attainment and other outcomes must be empirically assessed. In the following sections, we explore discontinuities on eligibility for federal subsidies for private higher education in Brazil to evaluate the impact of subsidies on low-ability students.

B Robustness Analysis

Table B.1: Eligibility Effect: Enrollment

Variables	Higher Education	Private H.E.	Public. H.E.	Higher Education (Robust)	Private H.E. (Robust)	Public H.E. (Robust)
Coeff	0.011 ***	0.013 ***	-0.002 ***	0.01 ***	0.012 ***	-0.002 ***
SE	(0.002)	(0.001)	(0.001)	(0.002)	(0.002)	(0.001)
BW	28.783	31.753	25.909	28.783	31.753	25.909
Local-Poly.	1	1	1	1	1	1
N	774977	849834	700943	1332020	1377131	1167871
Coeff	0.01 ***	0.012 ***	-0.002 ***	0.01 ***	0.012 ***	-0.002 ***
SE	(0.002)	(0.002)	(0.001)	(0.002)	(0.002)	(0.001)
BW	48.703	52.852	44.528	48.703	52.852	44.528
Local-Poly.	2	2	2	2	2	2
N	1248670	1336995	1155649	1711329	1717088	1749738
Coeff	0.01 ***	0.012 ***	-0.002 ***	0.009 ***	0.012 ***	-0.002 ***
SE	(0.002)	(0.002)	(0.001)	(0.002)	(0.002)	(0.001)
BW	67.06	72.453	72.15	67.06	72.453	72.15
Local-Poly.	3	3	3	3	3	3
N	1610177	1701686	1696745	1998972	2052604	2086925

Notes: This table presents the results of a regression discontinuity design on variables indicating enrollment. The final sample includes all students taking the ENEM exam between 2014 and 2015 who are expected to graduate from high school in that same year and who obtained a grade higher than zero on ENEM's essay—2,876,864 students total. In each column, we test whether crossing the eligibility threshold has a significant impact on enrollment. In columns (1) and (4) we test the impact on any type of enrollment (public or private), in columns (2) and (5) enrollment in private institutions, and in columns (3) and (6) enrollment in public institutions. We implement a data driven non parametric version of the RD design and select optimal bandwidths according to a MSE selection procedure (Calonico et al., 2015). We assess the robustness of our results using local polynomial estimators of various orders and implementing a bias-corrected robust inference procedure (Calonico et al., 2014)—columns (4), (5) and (6). Row *Coeff.* presents the estimate of treatment effect, row *S.E.* presents standard errors, row *B.W.* presents the optimal bandwidth, row *Local-Poly.* presents the order of the local polynomial estimator and row *N* presents the number of effective observations.

Table B.2: Eligibility Effect: Attainment - Enrolled by the end of 1st year

Variables	(1) Higher Education	(2) Private H.E.	(3) Public. H.E.	(4) Higher Education (Robust)	(5) Private H.E. (Robust)	(6) Public H.E. (Robust)
Coeff	0.0084 ***	0.0096 ***	-0.0011 **	0.0082 ***	0.0092 ***	-0.0011 **
SE	(0.001)	(0.001)	(5e-04)	(0.0012)	(0.0012)	(0.0006)
BW	37.148	32.082	27.922	37.148	32.082	27.922
Local-Poly.	1	1	1	1	1	1
N	1520542	1330836	1169205	2357602	2159349	1730395
Coeff	0.0081 ***	0.0092 ***	-0.0011 **	0.0079 ***	0.0092 ***	-0.0013 **
SE	(0.0013)	(0.0012)	(5e-04)	(0.0014)	(0.0014)	(0.0006)
BW	54.492	53.048	44.792	54.492	53.048	44.792
Local-Poly.	2	2	2	2	2	2
N	2108724	2064162	1792940	2758612	2638937	2618112
Coeff	0.0078 ***	0.0092 ***	-0.0013 **	0.0078 ***	0.0091 ***	-0.0014 **
SE	(0.0015)	(0.0014)	(0.0006)	(0.0016)	(0.0015)	(0.0006)
BW	70.276	71.398	72.372	70.276	71.398	72.372
Local-Poly.	3	3	3	3	3	3
N	2550820	2578792	2603013	3049645	3079287	3121912

Notes: This table presents the results of a regression discontinuity design on variables indicating persistence in the first year. The final sample includes all students taking the ENEM exam between 2014 and 2015 who are expected to graduate from high school in that same year and who obtained a grade higher than zero on ENEM's essay—2,876,864 students total. In each column, we test whether crossing the eligibility threshold has a significant impact on persistence. In columns (1) and (4) we test the impact on any type of persistence (public or private), in columns (2) and (5) persistence in private institutions, and in columns (3) and (6) persistence in public institutions. We implement a data driven non parametric version of the RD design and select optimal bandwidths according to a MSE selection procedure (Calonico et al., 2015). We assess the robustness of our results using local polynomial estimators of various orders and implementing a bias-corrected robust inference procedure (Calonico et al., 2014)—columns (4), (5) and (6). Row *Coeff.* presents the estimate of treatment effect, row *S.E.* presents standard errors, row *B.W.* presents the optimal bandwidth, row *Local-Poly.* presents the order of the local polynomial estimator and row *N* presents the number of effective observations.

Table B.3: Eligibility Effect: Attainment - Enrolled by the end of 2nd year

Variables	(1) Higher Education	(2) Private H.E.	(3) Public. H.E.	(4) Higher Education (Robust)	(5) Private H.E. (Robust)	(6) Public H.E. (Robust)
Coeff	0.0069 ***	0.008 ***	-0.0012 ***	0.0067 ***	0.0079 ***	-0.0013 ***
SE	(0.001)	(0.001)	(0.0005)	(0.0012)	(0.0012)	(0.0005)
BW	37.159	35.318	33.66	37.159	35.318	33.66
Local-Poly.	1	1	1	1	1	1
N	982369	937714	897042	1510343	1398960	1447605
Coeff	0.0066 ***	0.0079 ***	-0.0015 **	0.0063 ***	0.008 ***	-0.0017 **
SE	(0.0013)	(0.0011)	(0.0006)	(0.0014)	(0.0013)	(0.0006)
BW	54.257	55.545	43.037	54.257	55.545	43.037
Local-Poly.	2	2	2	2	2	2
N	1365744	1392169	1121371	1814904	1789237	1727850
Coeff	0.0062 ***	0.0079 ***	-0.0017 ***	0.006 ***	0.0079 ***	-0.0018 ***
SE	(0.0015)	(0.0013)	(0.0006)	(0.0016)	(0.0014)	(0.0007)
BW	71.331	74.585	69.443	71.331	74.585	69.443
Local-Poly.	3	3	3	3	3	3
N	1683263	1736258	1651821	2027165	2066895	2043225

Notes: This table presents the results of a regression discontinuity design on variables indicating persistence in the second year. The final sample includes all students taking the ENEM exam between 2014 and 2015 who are expected to graduate from high school in that same year and who obtained a grade higher than zero on ENEM's essay—2,876,864 students total. In each column, we test whether crossing the eligibility threshold has a significant impact on persistence. In columns (1) and (4) we test the impact on any type of persistence (public or private), in columns (2) and (5) persistence in private institutions, and in columns (3) and (6) persistence in public institutions. We implement a data driven non parametric version of the RD design and select optimal bandwidths according to a MSE selection procedure (Calonico et al., 2015). We assess the robustness of our results using local polynomial estimators of various orders and implementing a bias-corrected robust inference procedure (Calonico et al., 2014)—columns (4), (5) and (6). Row *Coeff.* presents the estimate of treatment effect, row *S.E.* presents standard errors, row *B.W.* presents the optimal bandwidth, row *Local-Poly.* presents the order of the local polynomial estimator and row *N* presents the number of effective observations.

Table B.4: Eligibility Effect: Attainment - Enrolled by the end of 3rd year

Variables	(1) Higher Education	(2) Private H.E.	(3) Public. H.E.	(4) Higher Education (Robust)	(5) Private H.E. (Robust)	(6) Public H.E. (Robust)
Coeff	0.0026 ***	0.0033 ***	-0.0008 **	0.0027 ***	0.0033 ***	-0.0008 **
SE	(0.0008)	(0.0007)	(0.0004)	(0.001)	(0.0009)	(0.0005)
BW	42.219	40.011	43.376	42.219	40.011	43.376
Local-Poly.	1	1	1	1	1	1
N	532302	507335	545610	786894	746101	796737
Coeff	0.002 **	0.003 ***	-0.0009 *	0.0017 **	0.0028 ***	-0.001 *
SE	(0.001)	(0.0009)	(0.0005)	(0.0011)	(0.001)	(0.0005)
BW	55.122	54.975	58.69	55.122	54.975	58.69
Local-Poly.	2	2	2	2	2	2
N	670595	669046	706045	951949	909916	991281
Coeff	0.0009	0.0023 **	-0.001 *	0.0006	0.0021 **	-0.0011 *
SE	(0.0012)	(0.001)	(0.0005)	(0.0013)	(0.0011)	(0.0006)
BW	67.292	69.149	92.092	67.292	69.149	92.092
Local-Poly.	3	3	3	3	3	3
N	785673	801893	971735	1011195	1022950	1201613

Notes: This table presents the results of a regression discontinuity design on variables indicating persistence in the third year. The final sample includes all students taking the ENEM exam between 2014 and 2015 who are expected to graduate from high school in that same year and who obtained a grade higher than zero on ENEM's essay—2,876,864 students total. In each column, we test whether crossing the eligibility threshold has a significant impact on persistence. In columns (1) and (4) we test the impact on any type of persistence (public or private), in columns (2) and (5) persistence in private institutions, and in columns (3) and (6) persistence in public institutions. We implement a data driven non parametric version of the RD design and select optimal bandwidths according to a MSE selection procedure (Calonico et al., 2015). We assess the robustness of our results using local polynomial estimators of various orders and implementing a bias-corrected robust inference procedure (Calonico et al., 2014)—columns (4), (5) and (6). Row *Coeff.* presents the estimate of treatment effect, row *S.E.* presents standard errors, row *B.W.* presents the optimal bandwidth, row *Local-Poly.* presents the order of the local polynomial estimator and row *N* presents the number of effective observations.

Table B.5: Robustness: - Enrollment in Higher Education Varying RD Cutoff

Variables	(1) c+5	(2) c+10	(3) c+25	(4) c+50	(5) c+75	(6) c+100	(7) c+150	(8) c+250
Coeff	0.002	0.001	-0.003 *	0.004 **	0.001	-0.002	-0.003	-0.009
SE	(0.002)	(0.002)	(0.001)	(0.002)	(0.002)	(0.003)	(0.003)	(0.008)
BW	21.561	21.575	39.059	27.008	33.964	28.354	52.098	24.583
Local-Poly.	1	1	1	1	1	1	1	1
N	611947	633963	1174542	830027	903716	604503	648972	70071
Coeff	0.001	0	0.003	0.005 ***	0.002	-0.003	-0.003	-0.01
SE	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)	(0.009)
BW	34.802	43.918	35.076	52.548	46.979	60.614	87.288	46.65
Local-Poly.	2	2	2	2	2	2	2	2
N	962788	1223291	1067816	1511357	1230142	1302379	1181470	138786
Coeff	0.002	0	0.002	0.007 ***	0.002	-0.002	0.004	-0.011
SE	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)	(0.004)	(0.011)
BW	69.574	71.624	65.064	92.075	80.613	72.282	75.493	52.377
Local-Poly.	3	3	3	3	3	3	3	3
N	1706451	1788245	1770289	2250628	1961428	1546750	991828	158726

Notes: This table presents the results of a placebo regression discontinuity design on enrollment. The final sample includes all students taking the ENEM exam between 2014 and 2015 who are expected to graduate from high school in that same year and who obtained a grade higher than zero on ENEM's essay—2,876,864 students total. In each column, we test whether crossing a placebo eligibility threshold has a significant impact on enrollment. Row names identify the placebo threshold and *c* represents the actual eligibility threshold. We implement a data driven non parametric version of the RD design and select optimal bandwidths according to a MSE selection procedure (Calonico et al., 2015). We assess the robustness of our results using local polynomial estimators of various orders and implementing a bias-corrected robust inference procedure (Calonico et al., 2014)—columns (4), (5) and (6). Row *Coeff.* presents the estimate of treatment effect, row *S.E.* presents standard errors, row *B.W.* presents the optimal bandwidth, row *Local-Poly.* presents the order of the local polynomial estimator and row *N* presents the number of effective observations.

Table B.6: Robustness: - Enrollment in Private Higher Education Varying RD Cutoff

Variables	(1) c+5	(2) c+10	(3) c+25	(4) c+50	(5) c+75	(6) c+100	(7) c+150	(8) c+250
Coeff	0.001	0	-0.002	0.002	0.002	-0.001	0.004	0.003
SE	(0.002)	(0.002)	(0.001)	(0.002)	(0.002)	(0.002)	(0.003)	(0.005)
BW	19.065	19.784	34.909	36.459	30.617	28.557	29.509	29.98
Local-Poly.	1	1	1	1	1	1	1	1
N	542973	583232	1063439	1097539	816567	608789	354053	86047
Coeff	0	-0.001	0.001	0.003	0.002	-0.002	0.004	0.002
SE	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)	(0.005)
BW	32.317	42.272	32.56	51.771	43.09	53.225	62.46	51.726
Local-Poly.	2	2	2	2	2	2	2	2
N	898437	1183911	997707	1492648	1134641	1143961	795078	156510
Coeff	0	-0.001	0.002	0.005 ***	0.003	-0.002	0.007 *	0.004
SE	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)	(0.004)	(0.007)
BW	59.293	74.812	55.406	95.881	74.527	70.568	65.942	57.122
Local-Poly.	3	3	3	3	3	3	3	3
N	1517757	1840021	1571882	2300745	1844828	1511495	846511	175963

Notes: This table presents the results of a placebo regression discontinuity design on enrollment in private higher education. The final sample includes all students taking the ENEM exam between 2014 and 2015 who are expected to graduate from high school in that same year and who obtained a grade higher than zero on ENEM's essay—2,876,864 students total. In each column, we test whether crossing a placebo eligibility threshold has a significant impact on enrollment. Row names identify the placebo threshold and *c* represents the actual eligibility threshold. We implement a data driven non parametric version of the RD design and select optimal bandwidths according to a MSE selection procedure (Calonico et al., 2015). We assess the robustness of our results using local polynomial estimators of various orders and implementing a bias-corrected robust inference procedure (Calonico et al., 2014)—columns (4), (5) and (6). Row *Coeff.* presents the estimate of treatment effect, row *S.E.* presents standard errors, row *B.W.* presents the optimal bandwidth, row *Local-Poly.* presents the order of the local polynomial estimator and row *N* presents the number of effective observations.

Table B.7: Robustness: - Enrollment in Public Higher Education Varying RD Cutoff

Variables	(1) c+5	(2) c+10	(3) c+25	(4) c+50	(5) c+75	(6) c+100	(7) c+150	(8) c+250
Coeff	0	0	0.001	0.002 **	0	-0.001	-0.003	-0.014 *
SE	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.008)
BW	29.364	27.857	27.013	26.21	38.327	36.52	36.775	23.138
Local-Poly.	1	1	1	1	1	1	1	1
N	821594	808327	839498	806643	1015724	780896	445363	65774
Coeff	0	0	0.001	0.003 ***	0	-0.001	-0.004	-0.013
SE	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.003)	(0.009)
BW	56.655	56.088	57.778	57.219	56.94	62.544	58.957	44.346
Local-Poly.	2	2	2	2	2	2	2	2
N	1465095	1497228	1622606	1619226	1466875	1344057	744607	131194
Coeff	0	0	0.001	0.002 ***	0	-0.001	-0.002	-0.016
SE	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.003)	(0.011)
BW	90.116	87.666	84.922	88.529	85.748	76.01	66.784	50.926
Local-Poly.	3	3	3	3	3	3	3	3
N	2009173	2024393	2094855	2200777	2053718	1622508	858829	153578

Notes: This table presents the results of a placebo regression discontinuity design on enrollment in public higher education. The final sample includes all students taking the ENEM exam between 2014 and 2015 who are expected to graduate from high school in that same year and who obtained a grade higher than zero on ENEM's essay—2,876,864 students total. In each column, we test whether crossing a placebo eligibility threshold has a significant impact on enrollment. Row names identify the placebo threshold and *c* represents the actual eligibility threshold. We implement a data driven non parametric version of the RD design and select optimal bandwidths according to a MSE selection procedure (Calonico et al., 2015). We assess the robustness of our results using local polynomial estimators of various orders and implementing a bias-corrected robust inference procedure (Calonico et al., 2014)—columns (4), (5) and (6). Row *Coeff.* presents the estimate of treatment effect, row *S.E.* presents standard errors, row *B.W.* presents the optimal bandwidth, row *Local-Poly.* presents the order of the local polynomial estimator and row *N* presents the number of effective observations.