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The Economic Effects of Free Elite Education: Evidence from a Flagship University in Brazil

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Abstract

This paper examines the labor market returns to attending free elite higher education for different socioeconomic and demographic groups in Brazil. Using restricted-access data from a flagship public university and income information from the tax registry of firms, we explore an entrance rule that generates exogenous variation close to admission cutoffs, allowing us to compare successful and non-successful applicants and to estimate the causal effect of enrollments on future salaries. The benefits are more pronounced among students from low income families and whose parents have lower education levels. Moreover, the low income students who enrolled at the elite university have higher chances of acquiring a college degree in the future. We also find higher earnings premiums from attending the high quality institution for women than for men. Our results contribute to the overall debate about the role of public universities in providing opportunities for social mobility for traditionally marginalized demographic groups.

JEL Classification: D31, I24, I23

Keywords: returns to education, tertiary schooling, Brazil

1 Introduction

Among developing countries, Brazil is known for having a significant fraction of its economically active population with lower levels of schooling. This is partly a legacy of the rare privilege to afford higher education. But over the past decades, access to higher education in Brazil has become more accessible, specially for young students. According to the Ministry of Education, enrollments in higher education institutions substantially enhanced from 2006-2016, in which the private (public) system represents 66% (59%) of this increase. In more recent years, the Government has gradually being implementing affirmative actions[1] to promote inclusion of minorities into federal public universities, including the most prestigious ones. Without this intervention, it is unlikely that these disadvantaged groups would attain these elite universities. In the private system, the entrance of poorer students into selective colleges is essentially made through scholarship grants. However, the private elite institutions continue to absorb the best-performing students, making attendance on flagship colleges, in many cases, a privilege for a few.

Given this scenario, the role of elite education on labor market performance is of particular importance and interest for guiding students' career decisions (Wong, 2012) and for policies that aim to promote access to the elite system. Using different research designs, the existing literature has found mixed findings (Brewer et al., 1999; Dale and Krueger, 2002, 2011; Black and Smith, 2004; Hoekstra, 2009; Anelli, 2016; Zimmerman, 2016; Jia and Hongbin, 2017). These studies have not focused on heterogeneous impacts in the context of free tuition, nor have they disaggregated effects by gender. Brazil is an ideal laboratory to explore this issue since the public universities do not charge tuition fees.

In this paper, we address this question and estimate the impacts of attending a free elite university on earnings, focusing on traditionally excluded groups. Using administrative data of one of the most recognized universities in Brazil, we match this information with restricted-access data on the universe of tax-registered firms and employ a regression discontinuity design that compare marginal applicants close to the admission cutoffs. Candidates compete to a place within programs — which they decided to apply prior to taking the entrance exam — and their admission is solely based on their final entrance score. The exogenous variation generated by the institutional entrance rule allows us to overcome the role of individual's ability and career preferences on labor outcomes and to estimate causal effects of enrollments.

[1]Given the high barriers for poorer background and low-performing students to entry in the elite education system, from 2012 the Ministry of Education introduced quotas to the public system for public high school students, indigenous, and Afro-descendants.

The heterogeneity of the elite education effect reveals interesting findings. While (non-free) selective education has been demonstrated to benefit more privileged groups (Hoekstra, 2009; Hastings et al., 2013; Zimmerman, 2016), we show the opposite in our context. Our results reveal that attending a free elite university increases future earnings for enrollees coming from low income families and parents with no college degree. Specifically, enrollments raise yearly salaries in about 35 p.p. (23 p.p.) in 10 (11) years after application. In contrast, we find no impact on earnings for the groups from higher socioeconomic backgrounds. We also find higher impacts for women than for men. The results are robust to a series of econometric specifications and to alternative bandwidths, and are not driven by unbalancing of baseline characteristics, selection into the formal labor market, or manipulation of the entrance score.

Due to the richness of our unique data, we also can exploit possible channels driving these labor returns. First, the elite enrolles who achieve higher premiums in the future are also more likely to be employed in the public sector, and this relationship is more evident among women. In Brazil, this sector is known for paying the highest salaries in the formal labor market and also for having an extremely competitive selection process.[2] Second, we find that elite students (among those in the formal labor market) have higher chances to acquire a college diploma after 10 years of application. This impact is more pronounced among low income peers and the difference is persistent from 7 years after application. Our econometric exercises confirm that higher premiums are not driven by work experience. In overall, all these evidences support the idea that free elite education can minimize some labor market gaps between groups and can promote disadvantaged individuals to better jobs and to higher levels of education.

Another important insight is related to the high opportunity costs associated to persistence on entering in the elite education and to decline the university's offer. Those admitted candidates coming from poor families and from public schools are less likely to attempt entry in the future and the poorer are also less prone to ever enroll in the elite university compared to their high income peers. Moreover, these same students are on average less likely to try to switch majors. Having wealthier backgrounds implies lower restrictions to students on new attempts to enter into the elite system, since their parents can finance the education – pre-college preparatory courses or even other colleges – until potential future admission or even while they are trying to change careers when are already inside the university. On the other hand, the poorest peers do not have the same options, so crossing the

[2]Despite having no data to perform a formal test, we interpret that this effect could also be related to the contribution of the elite university on individuals' human capital.

eligibility line makes them more susceptible to take the opportunity in the chosen career and remain on it until graduating in the long-run. Thus having the opportunity of free attendance in the elite system matters for financial disadvantaged individuals to reach a better life path in the future.

We add to the literature of elite education by estimating credible causal impacts of attending a free public university for traditionally marginalized socioeconomic and demographic groups. Moreover, our empirical findings have policy implications. Free elite education can promote income mobility and improve labor gains in the future for candidates whom parents didn't have the same opportunity in the past. Our findings contribute to policy debates related to affirmative actions by giving inputs to proposal interventions aiming on promoting disadvantaged groups to accessing high quality tertiary education.

The remainder of the paper is structured as follows. Section 2 discusses the institutional background. Section 3 presents detailed information on data sources, constructed variables, and sample. Section 4 explains the identification strategy. In section 5, we discuss the main empirical results and explore mechanisms leading elite returns. Finally, in Section 6, we conclude the paper.

2 Institutional Background

2.1 The Flagship University

UFPE (*Universidade Federal de Pernambuco*) was founded in 1948 and is currently the major flagship university in North and Northeast of Brazil and one of the top twenty public universities in the country, according to the Ministry of Education.[3] In addition to its high quality and reputation, it is a public university and does not charge tuition fees. Moreover, seats are not exclusively offered for local inhabitants, although only 16% of the candidates come from cities out of the Metropolitan Region of Recife, Pernambuco. Like most public universities in Brazil, UFPE is known for focusing on academic training. As a result, UFPE is the top choice of almost every high school student in the state of Pernambuco, regardless of their social class and career aspirations.

[3]Yearly, MEC performs a stringent evaluation of Brazilian Higher Education Institutions (private and public) based in a vast range of inputs related to infrastructure, quality of majors and teachers, management effectiveness, and student's academic performance. UFPE always have been figured at the twenty best Brazilian public universities since the first MEC evaluation and is currently in the 2nd percentile on the distribution of institutions quality. See Table A1 in the Appendix for the full list of institutions in the state of Pernambuco and their respectively national rank. More information about the evaluation process can be found at: http://portal.mec.gov.br.

The university offers 99 undergraduate programs[4] and, in general, is a four-year college, although some programs (34%) have a five-year duration.[5] Unlike in the US, the higher education system in Brazil requires that all students decide their major before applying to any college. Hence, at UFPE students must provide several socioeconomic and family background information as well as their major preference (only one option) a few months before taking the entrance exam. This implies that they compete for a spot at university only with those who choose similar majors. As we explain below, this setup is of particular importance for our empirical strategy and interpretation.

2.2 The Admission Process

Students are admitted to study solely based on their entrance exam performance called the *vestibular*. Anyone with a high school diploma or equivalent can apply to the university and, most importantly, their chances of being accepted depends exclusively on the *vestibular*. That is, the university cannot use any other admission criteria to leapfrog candidates.[6] About 68% of the candidates are students who have recently graduated from high school.[7] Half of these candidates is taking the *vestibular* for the first time and the other half is retaking it because they were not admitted in the previous year or plan to switch majors.[8] A small share of candidates apply from other institutions or study programs, graduated from the adult education program, or are not recent high school graduates.

The *vestibular* is held once per year over multiple days, with different subjects tested on each day. The exam has an initial stage with a broader scope covering all subjects and then a second round in which the candidate is tested in four specific subjects required by the intended major of study. In the first round, applicants are evaluated in the following subjects: Mathematics, Portuguese, a foreign language (English, French or Spanish), Literature, History, Geography, Physics, Chemistry, and Biology. The second-round exam comprises Portuguese (and a foreign language) and the three other subjects specifically required for the future program. The final entrance test score is a weighted average of the first- and second-round scores. Final entrance scores are eligible for consideration if none of

[4]This number does not include special programs, such as those focused on distance learning and high school teachers without college degree.

[5]Due to its complexity, students must attend six years of college education to graduate in Medicine.

[6]In 2015, all programs started adopting the new national centralized entrance process (Unified Selection System, SISU) to public universities in Brazil, ending institution-specific exams.

[7]Students with high age/grade distortion may obtain secondary schooling with a method called *supletivo*, which is an alternative method to compensate the disadvantages related to opportunities in higher education assess. It basically summarizes all high school program, which usually takes 3 years, in one intensive year course.

[8]The only option for switching majors for these cohorts was by applying in the next year.

the following exclusion criteria have been met: scoring 0 on one part, scoring below 2.5 on writing or scoring less than 80% of the mean of the intended major of study. Each program admits applicants ranked by final score until the seats are taken.[9]

On average, about 10% of the original candidates per program are admitted (Matta et al., 2016). Students do not know the cutoff scores at the time of the exam nor at the time of the application, as they vary from year to year. Neither students nor the university can manipulate final scores. The final classification of candidates, organized by class and major, is fully disclosed by the admission committee (*Comissão de Processos Seletivos e Treinamentos*, COVEST) through its website and printed on newspapers.

2.3 In-State Outside Options for Higher Education

Applicants who fail to be admitted at UFPE and wish to continue their education pathway have other private and public options in the state to acquire a higher degree diploma. The pool of non-selective institutions is predominantly private (65%) with the majority (75%) located in the metropolitan region of Recife. The private institutions charge very high tuition fees[10] and in recent years have been populated by students coming from the public secondary school system.[11] The low quality of public secondary schools is cited as a barrier to entry at UFPE. According to Cavalcanti et al. (2010), standardized test scores among public school students in Recife are on average about 4.2-17% lower than that observed for private school students.

The higher education market in Pernambuco, specially for private institutions, has shown impressive growth by the earlier 2000s. In 2006, there were 78 higher education institutions in the state, in contrast to the ninety options in 2016. Table A1 in the Appendix provides a description of the available in-state options, and demonstrates why UPFE ranks as the distinguished choice for candidates.

The most highly ranked alternative for students in the metropolitan region is the *Universidade Federal Rural de Pernambuco* (UFRPE), which is also a public university.[12] Among

[9]We note that these eligibility criteria are only binding among very low performing students, imposing no additional restrictions to our empirical strategy.

[10]Most institutions charge at least a monthly tuition of about .4 minimum salary, which represents about 30% of average wages in the metropolitan region of Recife. In overall, the more selective the major is the higher the tuition fees. For instance, majors like Law and Medicine cannot be afforded by the average people as costs almost double their earnings.

[11]To expand assess to higher education, MEC implemented conditional scholarship programs destined to candidates who fill specific achievement prerequisites and are unable to pay the private college's fees.

[12]Unlike UFPE, UFRPE is a reputable federal higher institution which offers programs focusing on agrarian sciences, which makes both universities complementary options.

privates, the best choice figures at the 241th national rank position. As in UFPE, the admission process for all these colleges is not centralized, allowing each of them to settle their own entrance rules. Despite these institutions offering a wide range of programs, they comprises only a subset of those available at UFPE.[13] As MEC establish standard requirements for regular operation of majors, the time to graduate within-majors and across colleges is usually the same. Furthermore, the vast majority of private colleges (profit-seeking) are more market-focused, while public and non-profit institutions, such as UFPE, focus on academic training and tend to have teaching programs in their portfolio.

3 Data

3.1 Data Sources, Variables, and Sample

3.1.1 Flagship College Applicants

To obtain detailed academic information about applicants, we use two different data sources. The first comes from the admission committee (COVEST) of UFPE, which provides detailed information about every UFPE applicant, including the entrance test score for those who applied over the period 2002-2014. As we describe above, the entrance test score is the only determinant of university admission, hence it is used as the running variable for our fuzzy RD strategy. The fuzziness comes from the possibility of admitted candidates rejecting UFPE's offer, so the compliance rate is not perfect. To eliminate time effects and student's major preferences at the time of application, we standardize the entrance test score by year and program using the last student eligible to take a place in the program of admission, and the standard deviation of applicants' scores.

The COVEST data also includes a wide range of candidate's socioeconomic characteristics at the time of application, such as age, employment status, if attended a public or private high school, if attended a pre-college preparatory course, parent's education, the number of times she did the *vestibular* in the past, and her motivation to enter the university and to choose the major preference. We generate binary indicators for all pre-determined student's traits. The information about the program chosen by the candidate is available only from the 2006 cohort, which means that we can't generate the program-specific thresholds for earlier cohorts.

Based on these information, we restrict our sample to candidates who have a second round score in our data from the cohorts 2006 and 2007. We use only these two cohorts

[13] Few institutions supply programs there are not included in UFPE's portfolio.

so that we can measure earnings in 2016 and 2017 when they are a better approximation of lifetime earnings, following Haider and Solon's (2006) research that finds that income measured at early ages is a poor proxy for permanent income. Our sample consists of 31,000 applicants, which includes all programs that have both open spots and excess demand (77%), conditions necessary for estimation. Table A2 illustrates the full list of UFPE programs and those included in our sample, with their expected time to graduate and field of study. We emphasize that the assignment variable distribution is obtained before we impose any restriction to the data, to make comparisons between compliers more reliable.

The second data is UFPE's Academic Information System (Sistema de Informações Acadêmicas, SIGA), which accurately relates the academic situation (active, graduated, or dismissed) of UFPE students until 2014 and, consequently, their enrollment status. While the entrance test score of the last admitted applicant determines the cutoff point, the enrollment determines the treatment status (a dummy variable) of the candidate. Aiming to cleanly estimate the returns of enrolling in a flagship university, we consider as enrolled those candidates who ever accepted the UFPE's offer at the time of application.[14] Assigning treatment on this manner informs the impact of free elite higher education for those who took the opportunity, which is of great interest for policy implications.

SIGA data is also valuable for recovering missing values of the gender variable obtained from COVEST, since the former has a precise registration regarding students' profile. For those who failed to be approved in *vestibular*, we recover the missing gender status on the Ministry of Finance. Unfortunately, with these two datasets we cannot track individuals who failed to enter at UFPE regarding their enrolment into other education institutions. On the other hand, we have the advantage to track the whole sample of candidates into the formal labor market in every year and their maximum level of education attained.

3.1.2 Labor Market Information

The outcomes of interest are obtained from the Yearly Social Information Report (*Relação Anual de Informações Sociais*, RAIS), which is a federal restricted-access data set collected by the Brazilian Ministry of Labor containing information on every tax-registered firms. These firms are legally required to report every worker formally employed during the previous calendar year, which generates around 65 million observations yearly. This data-set

[14] After enrolling in UFPE, students' academic pathway is uncertain. For instance, it is possible that, due to lack of motivation and persistence on finishing the chosen program, students decide to drop out or even switch programs between different colleges. Despite the fuzzy setting, the effect of interest would be more "like an intent-to-treat effect" since it captures the impact of attending the selective university regardless future withdrawal decisions.

provides national coverage of the Brazilian formal labor market at the employee-employer level, allowing us to obtain earnings, the number of weekly hours worked, and occupation for each UFPE applicant working up to 2017. Moreover, given that RAIS also have the individual highest education level attained and the required education to the job assigned, it is possible to explore different mechanisms behind the gains in the formal labor market, for example whether higher earnings arise from additional years of experience, quantity of education, or assignment to high skilled positions. Matching the different data sources at the individual level is possible because in all data-sets students are uniquely identified on the basis of their social security number, which is required at the time of application (i.e., upon registration to take the admission exam).

As we are interested in future returns to being admitted at UFPE, we measure individual labor outcomes 10 and 11 years after application — only the earlier cohort can be observed after 11 years in RAIS. For earnings, we use the sum of all salaries in a year (from 1th January to December 31) deflated to the December 2016 level using the Extended Consumer Price Index (IPCA). To make interpretation easier and comparable to other works, we use the log of earnings.

We also define a binary outcome indicating if the applicant was employed in public sector at least one time in the future. In Brazil, the public sector pays the highest salaries in the formal labor market and have an extremely competitive selection process. Thus, our intention is to explore a potential channel that could explain higher premiums. In addition, for those who are observed in RAIS, we generate a dummy variable indicating if the candidate acquired a college diploma.

In our design, all labor outcomes are conditioned to those who took a formal job in the future, implying that selection into the labor market may play a significant role in our results. We use RAIS to investigate employment status of the applicants and also to check if work experience drives the impact on earnings.

3.2 Descriptive Statistics

This section reports the summary statistics of our sample. Table 1 presents the data description segregated by enrolled and non-enrolled candidates — as well as for admitted and non-admitted candidates — and reveals that the different patterns are particularly marked among these two groups. We focus the discussion on enrollee vs non-enrollee since stats are very similar. As expected, enrollees have a much higher final entrance score than applicants who did not enroll due to the high level of competition. In the

labor market, they are more likely to be formally employed in the future (4 to 6 p.p. of difference), and in return, they achieve higher earnings. Despite the yearly earnings of enrolled applicants differs in about .3 p.p. with non-enrolled ones, the standard deviations suggest a very unequal distribution of gains in favor of non-enrollees. The hourly salary of UFPE applicants is almost twice the size of the average wage in the Recife metropolitan region, and it seems that enrolled students have even more advantageous returns to hour worked.

TABLE 1 ABOUT HERE

In terms of demographics, applicants have twenty one years old on average, are predominantly females (around 54%), and live in the state's capital at the time of application (about 90%). Non-admitted (and non-enrolled) students tried more times to enter in the university (almost two attempts) but, in the other hand, half of enrollees attended pre-college preparatory courses. Only a few fraction of candidates fully studied (primary and secondary degrees) in public schools.

The last part of Table 1 also confirms that candidates who are admitted in UFPE have better background. Indeed, they come from more wealthier families. Despite the high frequency of enrolled students having parents with lower levels of education, their parents are more well-educated than those in the control group. In addition, their personal preferences for choosing the major (university) are more related to the prestige of profession (university) and to self-fulfilment (quality of the program) compared to non-enrollees. In the next section, we explain how to disentangle these characteristics from the treatment effect of interest.

4 Estimation Strategy

We now focus on describing the empirical strategy we adopt to estimate the economic effects of attending a flagship university in Brazil. Estimating credible effects of going to a selective university is difficult due to many sources of selection bias. Given the high competition, admitted applicants to elite universities (tend to) belong to the pool of high-ability individuals, and this profile is highly associated with better family background and better school education. This implies that observed and unobserved students traits are essentially correlated with the opportunity of attending a selective university. To undermine confounding factors related to the treatment effect of interest, we use the admission cutoffs in a regression discontinuity design to compare marginally accepted to marginally non-accepted students.

Consider y_{imc} a individual i's labor market outcome and x_{imc} the individual i's entrance test score. Since our research design uses admission cutoffs as exogenous shocks to being accepted at UFPE, we define A_{imc} as a dummy equal to one if individual i is admitted to program m in cohort c, where $A_{imc} = 1[x_{imc} \geq 0]$, and consider the following model:

$$y_{imc} = \alpha \cdot A_{imc} + g(x_{imc}) + u_{imc}. \tag{1}$$

The function $g(\cdot)$ captures the systematic relationship between entrance test scores and the outcomes of interest and the coefficient α measures the discontinuity in this relationship around the admission cutoffs. u_{imc} is an error term. This reduced form captures the intent-to-treat effect of attending the selective university for students marginally accepted at UFPE. If every candidate admitted to UFPE wanted to enroll, α would reveal the local treatment effect of interest in a sharp discontinuity design. Since the compliance rate is not perfect because some accepted applicants can decline university invitation, to estimate the LATE we must consider the probability of enrolling in the program of admission as a first stage. Hence, consider the model

$$P(enroll_{imc}) = \beta \cdot A_{imc} + h(x_{imc}) + \epsilon_{imc}, \tag{2}$$

where $enroll_{imc}$ is a binary variable equal to one if individual i in cohort c enrolled in program m. The coefficient β measure the correlation between being accepted and enrolling in the program (or the likelihood of enrollment if admitted to UFPE), which is expected to be significantly high, given take up rates. To recover the returns to attending an elite university we therefore take the ratio of the two estimated parameters, $\hat{\alpha}$ and $\hat{\beta}$, that is given by the following estimand:

$$\tau = \frac{\lim_{x \downarrow \underline{x}} E(y|x \geq \underline{x}_k) - \lim_{x \uparrow \underline{x}} E(y|x < \underline{x}_k)}{\lim_{x \downarrow \underline{x}} E(enroll|x \geq \underline{x}_k) - \lim_{x \uparrow \underline{x}} E(enroll|x < \underline{x}_k)} = \frac{\hat{\alpha}}{\hat{\beta}} \tag{3}$$

Equation 3 means that, in a small boundary around the admission cutoff, we are taking the average difference in returns between candidates who barely were admitted and are surely enrolled at UFPE and those who were not admitted to UFPE by a small margin. Using observations inside a small window around the threshold is crucial to the identification strategy, which ensures that we are comparing more similar individuals. To obtain the optimal bandwidth and standard errors we use the selection procedures from Calonico et al. (2014) and Calonico et al. (2016) (CCT hereafter). Furthermore, we exploit robustness of results by testing alternative ranges of bandwidths, as well as by including second order polynomials — as suggested by Gelman and Imbens (2017).

Since there exists a different cutoff for each program in each year, we follow Pop-Eleches and Urquiola (2013) and Zimmerman (2016) and stack the data across all cutoffs, that is, we normalize each cutoff to zero by year and major. The immediate consequence is that an individual shall appear in the data two times, do to her attempts on entering in the university or even trying to switching majors. To deal with this issue, we cluster the standard errors at the student level when doing causal inference.

At the time the candidates take the exams, as well as when they apply for admission, they do not know what the exact cutoff will be since it varies each year. That is, there is no reason to believe that more ambitious students can manipulate their scores or that the university manipulates scores. Nevertheless, we further examine discontinuity in the density of scores at the threshold to check this possibility of sorting. We also implement balance tests of the pre-treatment variables by replacing our outcomes of interest for the socioeconomic and background characteristics described in the previous section. In addition, we focus on exploring the effects segregated by groups aiming to understand in which social groups our results are more or less expressive.

5 Results

Our results are divided into four parts. First, we verify how admission cutoffs explain enrollments in the elite university and provide tests to validate our empirical strategy. Second, we investigate the difference in behaviours among social groups regarding their attempts on trying to get access into the free elite education system. In the next section, we explore the average net effects of enrollments on earnings for each of our samples. Finally, we exploit some links that can explain our main results.

5.1 First-Stage Estimates and Validation

This section provides empirical evidence about the strength and validity of our identification strategy. We start by showing the compliance rate for marginal applicants. The first panel of Figure 1 reveals a jump in the probability of enrollment at the entrance score cutoff. Marginally admitted candidates are 85% more likely to enroll, and this estimate is highly significant.

Figure 1 About Here

All our main findings, discussed in the next section, are obtained restricting the sample

for individuals who were employed in the future. So one may ask if, on the extensive margin, the instrument is locally strong enough to induce admitted applicants to enroll at the university. The second panel of Figure 1 reports the estimated discontinuity conditioned for those who were working 10 or 11 years after application. The size of the coefficient is almost unchanged and the loss of around 32% in the sample do not compromise statistical power as the standard error remains very low.

We now investigate the discontinuities among three different groups, divided by: school type, parents' education, and family income level. Table 2 reveals that admitted candidates with less educated parents and those coming from poorer families are much more likely to get enrolled then their counterparts. The high take up rate reflects the high opportunity cost of declining the flagship university's (free) offer, specially for those students with poorer backgrounds.

Table 2 About Here

The first-stage results indicate that admission cutoffs indeed raise the probability of attending the selective university, but we still may find some threats to exogeneity. One threat relates to the possibility of manipulation of the entrance test score. Applicants are unaware of the cutoff score when taking the entrance exam, so we should expected no clumping in the distribution of the running variable at the right-side of the threshold. The McCrary test performed in Figure 2 formally tests the continuity of the entrance score density, confirming no manipulation around the admission cutoff neither to the whole sample nor conditioning to employed students.

Figure 2 About Here

A second issue to worry about is the balance of pre-determined variables. If unobservable and observable characteristics are correlated with the treatment status our regression discontinuity design would not be valid. We test balance of baseline traits for all sample and restricting for applicants employed in the future. Table 3 shows that, using the whole sample, there is no evidence of unbalancing in observed characteristics. In the last column we perform the balance check using the sample with employed candidates and the results remains unaffected. Since characteristics of marginally employed applicants are well balanced, we have strong support for the validity of our strategy.

Table 3 About Here

5.2 Trying to get access

Now we discuss threshold crossing effects on the attempts to get access to the elite university. We start by presenting evidences of the chance of trying to get access to the university as a function of candidates' entrance scores. All estimates are calculated using local regressions with first order polynomials and CCT's optimal bandwidths.

Table 4 reports the effect of admission at the elite university on the probability of trying another *vestibular*. The reduced form estimates on the first row indicates that females and students with poorer backgrounds who did not crossed the threshold are less likely to try other *vestibulars* in the future compared to their counterpart groups. It could be reflecting how challenging it is to candidates with poorer backgrounds get admitted in the university, specifically for those with less educated parents and lower income levels. This behaviour could justify why admitted students from traditionally excluded groups are more prone to enroll in UFPE if admitted, as can be seen from Table 2.

Table 4 About Here

We also find the same pattern for candidates who never enrolled before at the university (second row). The third row shows that top income applicants and those coming from private schools are more likely to try other *vestibular* if they are already in the university. Probably, this could reflect the lower cost for wealthy groups on switching majors.

5.3 Enrollment Effects

The previous subsections suggest that individuals coming from typically marginalized groups could be facing higher opportunity costs on trying to switch majors or even to decline the university seat compared to their counterpart groups. Now we are interested on the labor returns for those who embraced the opportunity to selective education at the margin of admission cutoff, exploring these impacts across the different socioeconomic and demographic groups. To do so, we exploit local average treatment effects using enrollment in UFPE as the treatment status on our regression discontinuity approach.

Table 5 exploits the difference in the probability of being observed in the formal labor market data (RAIS) between compliers across all social groups of interest. The numbers in the table certify that selection into the formal labor market is not a concern. On the extensive margin, both enrolled and non-enrolled candidates are (statistically) equally likely to have formal earnings measured 10 and 11 years later.

Table 5 About Here

Now we turn to the main results in the Table 6. Focusing on earnings 10 an 11 years after application to UFPE, our fuzzy estimates show that, on average, candidates who ever enrolled in the flagship university earn more than non-enrollees, and this difference is significant at conventional inference benchmarks. When investigating the heterogeneous returns to elite education, the traditionally marginalized groups are the most benefited ones. Ten years latter, the earnings are 33-36 p.p. higher for low income students and for students whom parents are less educated. The earnings drop one year later (to 23-24 p.p.), but remain highly statistically significant. We also find higher and significant effects on earnings for enrolled women, and the difference increased in the 11th year after matriculation. Despite the positive magnitude found for men, we cannot confirm statistical difference. We found no gap on returns among wealthier students and with better background.

Table 6 About Here

5.4 Exploiting Channels

In addition to examine the net effect of going to a flagship university, we try to enlighten possible mechanisms that could be driving the earning premiums. Differently from Zimmerman (2016) and Jia and Hongbin (2017), we cannot distinguish channels related to college reputation, class ranking or even social networks (peer ties) since we do not clearly observe the education pathway of non-admitted applicants. Alternatively, we can investigate possible explanations emerged from the labor market side related to the quantity of education, type of job, and work experience.

On Table 7 we attempt to explore potential mechanisms that could explain our main findings related to type of job and education level. We first show some evidences on the probability of taking a job in the public sector for the elite students. The impacts appear consistently for the baseline sample, and it seems that is driven mainly by females. Using the information from RAIS about the individual education level, we also find that the enrollment in the elite university raises the chance of attaining a higher graduation, at least among lower income students. The effect persists 10 and 11 years after application, which is a sufficient time span for candidates to acquire a post-secondary graduation.

Table 7 About Here

The bottom part of Table 7 confirms that these students are, in fact, UFPE graduates since the coefficients are very similar with those using the information obtained from RAIS.

Despite the competitive entrance to the university, charging no tuition fees seems relevant for poorer students to reach a higher degree diploma.

In Table 8, we include the number of years (continuous variable) an individual appeared in RAIS as a proxy for work experience. Comparing with the main results, the estimates on the table show that work experience does not seem to explain the higher premiums for elite students.

TABLE 8 ABOUT HERE

6 Concluding Remarks

UFPE's entrance exams produce an ideal quasi-experiment using admission cutoffs to investigate the role of elite post-secondary education on future labor market outcomes. Applying a standard RD design we disentangle the influence of ability and other personal (observed and unobserved) traits from the outcome of interest, allowing us to interpret causal impacts.

Our preliminary results are very promising and contribute to the global debate on the role of public universities in earnings mobility. In contrast to papers that have studied impacts of high cost institutions and/or elite programs we have found larger impacts of enrolling in a tuition free university among candidates from lower socioeconomic backgrounds. In the short-run, income-constrained candidates who miss the cut-off do not have the same options as candidates from high income backgrounds which ultimately affects lifetime earnings. We are exploring whether the larger premiums realized for female candidates and low-income candidates arise from the composition of courses offered at UFPE, or differential time-use among candidates who just missed the cutoff. While the free tuition appears to play an important role for the students applying from the most marginalized backgrounds, there are other policies such as income-targeted scholarships that may be more cost-effective in promoting access to high quality tertiary education.

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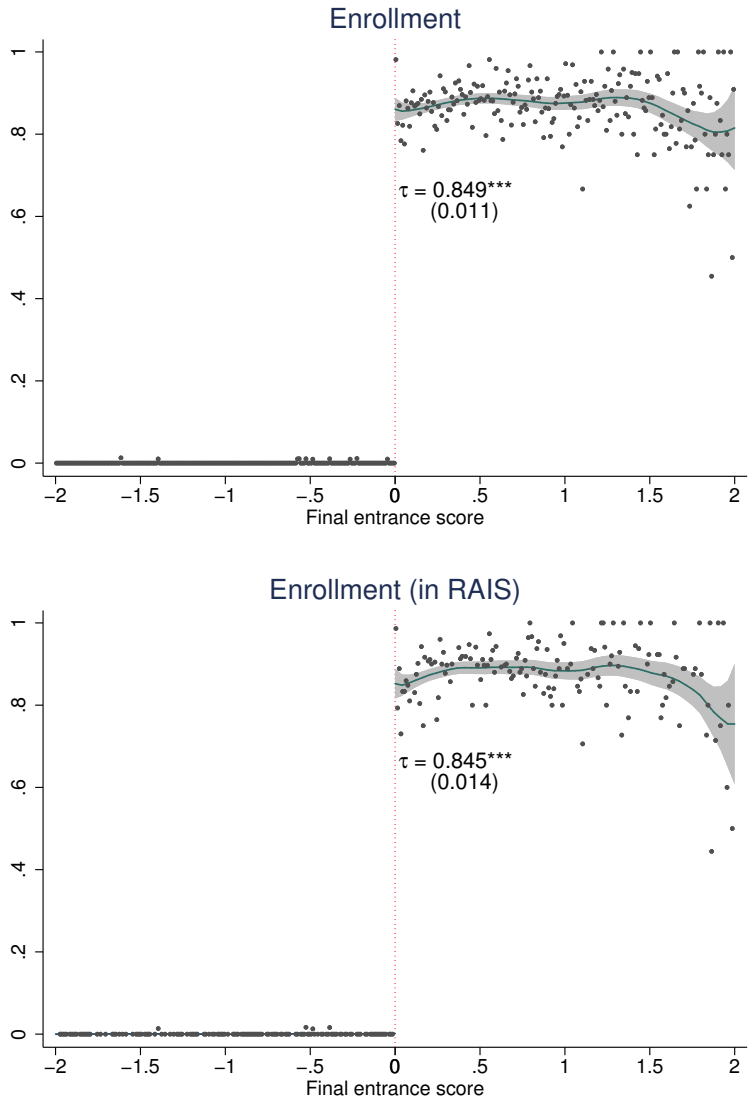
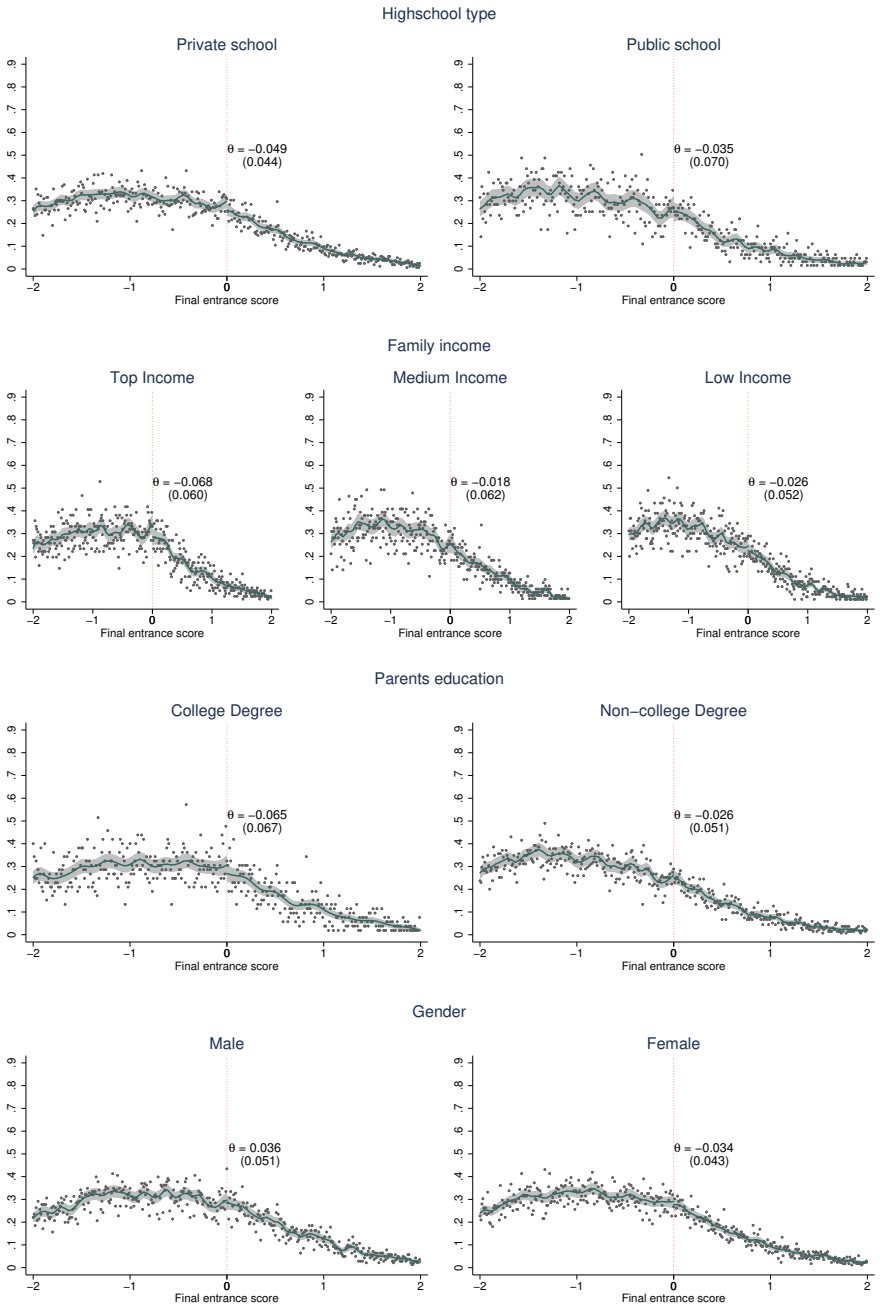
Figure 1: First stage results



This figure shows the relationship between the final entrance score and enrollment at the elite university. Panel A includes the whole sample of applicants, and Panel B restricts the sample to applicants observed in the formal labor market.

Figure 2: Manipulation Test



This figure shows the McCrary test for the different socioeconomic and demographic groups. Final entrance score is standardized by program and year. θ is the Cattaneo et al. (2017) estimator for density discontinuity, with robust standard error in parentheses. ***, **, * represent statistical significance at the 1%, 5% and 10% levels, respectively.

Table 1: Descriptive Statistics

	Admitted		**Non-admitted**		**Enrolled**		**Non-enrolled**	
	mean	s.d.	mean	s.d.	mean	s.d.	mean	s.d.
				Outcomes				
Employed after 10 years	0.670	0.470	0.630	0.483	0.671	0.470	0.630	0.483
Employed after 11 years	0.680	0.467	0.617	0.486	0.682	0.466	0.618	0.486
Graduated after 10 years	0.823	0.382	0.700	0.458	0.820	0.385	0.706	0.456
Graduated after 11 years	0.846	0.361	0.721	0.448	0.841	0.366	0.726	0.446
(log)Earnings after 10 years	10.657	0.941	10.296	0.997	10.619	0.927	10.319	1.004
(log)Earnings after 11 years	10.783	0.892	10.384	0.972	10.733	0.888	10.405	0.977
				Characteristics				
Final entrance score	0.747	0.663	-1.241	0.771	0.735	0.649	-1.152	0.877
Female	0.515	0.500	0.563	0.496	0.515	0.500	0.561	0.496
Age	21.50	4.937	21.30	5.294	21.55	4.889	21.29	5.298
Took pre-vestibular prep. course	0.556	0.497	0.450	0.498	0.553	0.497	0.453	0.498
Living in capital	0.928	0.259	0.876	0.330	0.911	0.285	0.876	0.329
All in public schools	0.142	0.349	0.178	0.383	0.142	0.349	0.176	0.380
Income brackets								
Low income	0.317	0.465	0.388	0.487	0.324	0.468	0.383	0.486
Medium income	0.286	0.452	0.294	0.456	0.295	0.456	0.293	0.455
Top income	0.397	0.489	0.319	0.466	0.381	0.486	0.325	0.468
Parents education								
Both parents with college degree	0.255	0.436	0.205	0.404	0.248	0.432	0.207	0.405
Neither parent with college degree	0.495	0.500	0.571	0.495	0.505	0.500	0.567	0.496
Reason to choose major								
Prestige of the major/profession	0.017	0.131	0.030	0.171	0.017	0.128	0.030	0.170
Quality of the program	0.086	0.280	0.088	0.283	0.083	0.275	0.088	0.284
Personal self-fulfilment	0.574	0.494	0.531	0.499	0.579	0.494	0.531	0.499
Other	0.322	0.467	0.351	0.477	0.322	0.467	0.351	0.477
Reason to choose UFPE								
No tuition fees	0.349	0.477	0.383	0.486	0.361	0.480	0.380	0.485
University prestige	0.279	0.449	0.256	0.436	0.266	0.442	0.259	0.438
Quality of programs	0.267	0.442	0.276	0.447	0.259	0.438	0.277	0.448
Other reasons	0.105	0.307	0.085	0.279	0.114	0.318	0.085	0.278
Number of observations	8,011		23,004		6,979		24,036	

The sample comprises candidates from 2006 and 2007 cohorts.

Table 2: Reduced forms - Enrollment in UFPE

		School type			**Parents education**			**Income**			
	All	Private	Public	Δ	College	No-college	Δ	Top	Medium	Lowest	Δ
Enrolled	0.849***	0.860***	0.845***	✗	0.835***	0.880***	✓	0.846***	0.897***	0.846***	✗
	(0.011)	(0.016)	(0.025)		(0.025)	(0.018)		(0.023)	(0.023)	(0.022)	
Ever enrolled	0.536***	0.544***	0.564***	✗	0.457***	0.611***	✓	0.575***	0.596***	0.509***	✓
	(0.016)	(0.022)	(0.034)		(0.043)	(0.027)		(0.030)	(0.037)	(0.032)	

This table reports admission effects (reduced forms) on different enrollment definitions. "Enrolled" are students who matriculated at the time of application, and "ever enrolled" are those students who matriculated at UFPE any year after application (until 2014). Each cell represents a different regression. RDs are estimated using triangular kernels. The bandwidth for entrance score is selected by using Calonico et al.'s (2014) procedure. The columns with "Δ" represent the difference between the coefficients "(l)-(r)" obtained from seemingly unrelated regressions, and "✓" means statistical significance at 10% level or lower. Standard errors (clustered at student level) are in parentheses. ***, **, * represent statistical significance at the 1%, 5% and 10% levels, respectively.

Table 3: Balance test

	Reduced Form	Enrolled	Enrolled (in RAIS)
Female	-0.017	-0.022	-0.021
	(0.019)	(0.023)	(0.027)
Age	0.137	0.189	0.195
	(0.209)	(0.258)	(0.269)
Took pre-vestibular prep. course	-0.031	-0.039	-0.015
	(0.025)	(0.032)	(0.034)
Living in capital	-0.002	-0.002	-0.008
	(0.013)	(0.016)	(0.016)
All in public schools	-0.006	-0.017	-0.005
	(0.016)	(0.025)	(0.021)
Income brackets			
Low income	0.007	0.009	0.002
	(0.022)	(0.025)	(0.028)
Between income	-0.004	0.004	-0.007
	(0.021)	(0.026)	(0.030)
Top income	-0.004	-0.006	0.011
	(0.023)	(0.027)	(0.031)
Parents education			
Both parents with college degree	-0.016	-0.016	-0.005
	(0.020)	(0.021)	(0.027)
Neither parent with college degree	0.033	0.034	0.029
	(0.024)	(0.026)	(0.033)
Reason to choose major			
Prestige of the major/profession	0.006	0.005	0.012
	(0.007)	(0.010)	(0.012)
Quality of the program	-0.003	-0.006	-0.014
	(0.014)	(0.014)	(0.020)
Personal self-fulfillment motivation	0.000	0.005	0.010
	(0.025)	(0.028)	(0.037)
Other	-0.002	-0.009	-0.009
	(0.024)	(0.030)	(0.035)
Reason to choose UFPE			
No tuition fees	0.013	0.027	0.029
	(0.025)	(0.025)	(0.032)
University prestige	-0.024	-0.028	-0.032
	(0.022)	(0.024)	(0.030)
Quality of programs	-0.014	-0.018	-0.014
	(0.022)	(0.023)	(0.029)
Other reasons	0.012	-0.008	-0.002
	(0.026)	(0.025)	(0.029)

This table reports sharp and fuzzy RD estimates of the enrollment effect on pre-determined characteristics. Each cell represents a different regression. The last column includes candidates who were found at least once on 10 or 11 years after application. RDs are estimated using triangular kernels. The bandwidth for entrance score is selected by using Calonico et al.'s (2014) procedure. Standard errors (clustered at student level) are in parentheses. ***, **, * represent statistical significance at the 1%, 5% and 10% levels, respectively.

Table 4: Admission effects on attempts to get access to UFPE

		Income			School type		Parents education		Gender	
	All	Top	Medium	Lowest	Private	Public	College	No-college	Male	Female
Tried other vestibular	-0.390***	-0.395***	-0.385***	-0.369***	-0.388***	-0.376***	-0.419***	-0.358***	-0.372***	-0.400***
	(0.015)	(0.032)	(0.036)	(0.031)	(0.023)	(0.040)	(0.039)	(0.027)	(0.025)	(0.021)
Tried other vestibular if not-enrolled before	-0.428***	-0.453***	-0.424***	-0.394***	-0.438***	-0.372***	-0.453***	-0.409***	-0.430***	-0.427***
	(0.014)	(0.028)	(0.031)	(0.028)	(0.020)	(0.033)	(0.033)	(0.023)	(0.021)	(0.019)
Tried other vestibular if enrolled before	0.037***	0.052***	0.043***	0.019	0.052***	0.009	0.038**	0.047***	0.054***	0.022**
	(0.006)	(0.014)	(0.016)	(0.013)	(0.010)	(0.013)	(0.016)	(0.012)	(0.011)	(0.009)

This table reports admission effects on trying other vestibulars. Each cell represents a different regression. RDs are estimated using triangular kernels. The bandwidth for entrance score is selected by using Calonico et al.'s (2014) procedure. Standard errors (clustered at student level) are in parentheses. ***, **, * represent statistical significance at the 1%, 5% and 10% levels, respectively.

Table 5: Enrollment effects on formal employment

		Income			**School type**		**Parents education**		**Gender**	
	All	Top	Medium	Lowest	Private	Public	College	No-college	Male	Female
After 10 years	0.012	0.012	0.078	0.029	0.016	0.044	0.034	0.016	-0.020	0.020
	(0.025)	(0.048)	(0.058)	(0.047)	(0.035)	(0.047)	(0.056)	(0.037)	(0.035)	(0.035)
After 11 years	0.000	0.024	0.001	-0.036	0.009	0.002	-0.056	0.003	-0.017	-0.013
	(0.022)	(0.048)	(0.056)	(0.050)	(0.033)	(0.058)	(0.067)	(0.035)	(0.034)	(0.033)

This table reports fuzzy RD estimates of the enrollment effect on the probability of being observed in RAIS (formal labor market). Each cell represents a different regression. RDs are estimated using triangular kernels. The bandwidth for entrance score is selected by using Calonico et al.'s (2014) procedure. Standard errors (clustered at student level) are in parentheses. ***, **, * represent statistical significance at the 1%, 5% and 10% levels, respectively. P-values are in backets.

Table 6: Enrollment effects on earnings

		Income			**School type**		**Parents education**		**Gender**	
	All	Top	Medium	Lowest	Private	Public	College	No-college	Male	Female
After 10 years	0.151**	-0.067	0.057	0.334***	0.141	0.184	-0.252	0.362***	0.108	0.134*
	(0.067)	(0.120)	(0.115)	(0.125)	(0.095)	(0.140)	(0.174)	(0.110)	(0.099)	(0.078)
After 11 years	0.116**	0.018	0.062	0.199**	0.132	0.176	0.090	0.257***	0.052	0.172**
	(0.058)	(0.117)	(0.101)	(0.100)	(0.084)	(0.141)	(0.148)	(0.089)	(0.087)	(0.082)

This table reports fuzzy RD estimates of the enrollment effect on (log)earnings. Each cell represents a different regression. RDs are estimated using triangular kernels. The bandwidth for entrance score is selected by using Calonico et al.'s (2014) procedure. Standard errors (clustered at student level) are in parentheses. ***, **, * represent statistical significance at the 1%, 5% and 10% levels, respectively. P-values are in backets.

Table 7: Exploring potential channels

		Income			School type		Parents education		Gender	
	All	Top	Medium	Lowest	Private	Public	College	No-college	Male	Female
Employed in Public Sector										
After 10 years	0.056*	-0.013	0.054	0.055	0.007	0.060	-0.083	0.078*	0.021	0.084*
	(0.033)	(0.066)	(0.067)	(0.056)	(0.046)	(0.066)	(0.087)	(0.046)	(0.046)	(0.045)
After 11 years	0.071**	0.033	0.178**	0.032	0.051	0.040	0.047	0.040	0.042	0.090**
	(0.033)	(0.065)	(0.078)	(0.057)	(0.048)	(0.066)	(0.087)	(0.042)	(0.047)	(0.044)
Graduation										
After 10 years	0.048*	-0.014	0.042	0.108*	0.019	0.071	0.028	0.072	0.016	0.081**
	(0.027)	(0.039)	(0.058)	(0.056)	(0.033)	(0.068)	(0.049)	(0.046)	(0.041)	(0.035)
After 11 years	0.034	-0.020	0.015	0.091*	0.010	0.037	0.016	0.062	0.018	0.056*
	(0.024)	(0.035)	(0.055)	(0.053)	(0.031)	(0.065)	(0.047)	(0.043)	(0.038)	(0.030)
Graduation at UFPE										
After 10 years	0.034*	-0.009	0.046	0.115***	0.041*	0.053	0.034	0.051	0.053*	0.024
	(0.020)	(0.032)	(0.046)	(0.037)	(0.021)	(0.054)	(0.040)	(0.037)	(0.030)	(0.024)
After 11 years	0.031	-0.030	0.044	0.092**	0.032	0.042	0.013	0.054	0.044	0.029
	(0.019)	(0.031)	(0.041)	(0.041)	(0.022)	(0.052)	(0.040)	(0.034)	(0.028)	(0.024)

This table reports fuzzy RD estimates of the enrollment effect on the probability of being employed in the public sector and on graduation. Each cell represents a different regression. RDs are estimated using triangular kernels. The bandwidth for entrance score is selected by using Calonico et al.'s (2014) procedure. Standard errors (clustered at student level) are in parentheses. ***, **, * represent statistical significance at the 1%, 5% and 10% levels, respectively. P-values are in backets.

Table 8: Enrollment effects on earnings controlling for experience

		Income			School type		Parents education		Gender	
	All	Top	Medium	Lowest	Private	Public	College	No-college	Male	Female
Earnings - *Controlling for experience*										
After 10 years	0.143**	-0.096	0.052	0.349***	0.123	0.191	-0.252	0.332***	0.089	0.138*
	(0.065)	(0.116)	(0.113)	(0.121)	(0.093)	(0.131)	(0.169)	(0.107)	(0.094)	(0.078)
After 11 years	0.103*	-0.018	0.055	0.185*	0.113	0.126	0.093	0.217**	0.024	0.170**
	(0.057)	(0.113)	(0.100)	(0.097)	(0.082)	(0.132)	(0.144)	(0.087)	(0.084)	(0.082)

This table reports fuzzy RD estimates of the enrollment effect on earnings using the number of years as control variables. Each cell represents a different regression. RDs are estimated using triangular kernels. The bandwidth for entrance score is selected by using Calonico et al.'s (2014) procedure. Standard errors (clustered at student level) are in parentheses. ***, **, * represent statistical significance at the 1%, 5% and 10% levels, respectively. P-values are in backets.

A Appendix

Table A1: Higher Education Institutions in Pernambuco

Institution	Rank	Type	# of programs	Teach. programs	Enrollees	Grad. stud.	Prop. PhD. professors	Institution	Rank	Type	# of programs	Teach. programs	Enrollees	Grad. stud.	Prop. PhD. professors
UFPE	46	**University**	**105**	**29**	**32,137**	**3,971**	**0.709**	FJN	1,286	College	13	1	5,626	786	0.151
UFRPE	100	University	47	16	11,572	1,182	0.747	FPDMB	1,306	College	9	6	1,143	239	0.075
UNIVASF*	204	University	11	1	3,296	360	0.544	FCHPE	1,349	College	3	0	897	187	0.217
FNR	241	College	5	0	1,153	59	0.099	FACHO	1,367	College	6	2	1,412	245	0.162
FSH	285	College	3	0	1,509	205	0.250	FALUB	1,373	College	4	2	1,029	253	0.113
FACETEG*	292	College	2	0	675	90	0.100	FAREC	1,375	College	8	0	1,290	305	0.047
FOCCA	356	College	8	1	1,888	190	0.211	IBRATEC	1,399	College	6	0	963	153	0.058
FACIPE	449	College	16	0	3,051	602	0.329	FADIC	1,536	College	4	0	1,011	116	0.408
FAINTVISA*	453	College	18	5	2,580	489	0.185	FACESF	1,537	College	2	0	979	82	0.081
FASNE	465	College	4	1	759	71	0.174	FAFICA*	1,545	College	11	5	1,123	350	0.086
IBGM / FGM	479	College	22	1	6,022	1,157	0.232	FACAPE*	1,558	College	10	0	3,829	430	0.087
FACET*	495	College	2	1	311	75	0.074	IESO	1,580	College	2	0	287	91	0.136
FBV	503	College	43	0	4,957	650	0.234	FAMA	1,601	College	3	0	386	154	0.094
FEPAM	529	College	1	0	104	15	0.087	FIS	1,624	College	9	0	2,122	281	0.076
FACIG	560	College	8	2	1,263	235	0.204	FACOTTUR	1,625	College	11	0	1,192	109	0.180
FIR	630	College	24	0	10,632	1,061	0.185	FAGA*	1,715	College	3	0	505	100	0.093
UNIFAVIP*	633	Univ. Center	30	0	8,825	1,016	0.180	IPESU	1,721	College	11	0	1,653	260	0.056
FG	649	College	40	1	11,003	1,686	0.117	ISEF*	1,733	College	1	1	89	44	0
FAJOLCA	654	College	3	1	596	123	0.176	FATIN	1,768	College	2	0	634	160	0.111
FCHE	692	College	5	0	1,815	338	0.299	UNESJ	1,790	College	20	1	2,695	543	0.114
FMN Caruaru	703	College	12	1	2,737	241	0.107	ESSA*	1,815	College	4	1	553	92	0.129
FACHUSST	707	College	1	0	173	42	0.278	CESA*	1,816	College	7	6	1,149	306	0.099
UPE	712	University	56	24	14,313	1,631	0.463	ESM	1,819	College	2	0	296	43	0.103
UNICAP	737	University	37	9	9,805	1,464	0.440	FASUP	1,826	College	2	1	160	4	0.308
FAC. S. MIGUEL	779	College	18	1	3,247	170	0.233	FACEG	1,856	College	1	0	608	56	0.077
IFPE	792	Univ. Institute	17	7	2,798	262	0.239	FSM	1,917	College	2	0	12	0	0.167
IESP	796	College	1	0	45	33	0	CESVASF*	1,918	College	8	8	892	94	0.022
FACOL*	803	College	13	1	2,974	467	0.185	FAMASUL*	1,926	College	6	6	929	309	0.075
FIBAM	829	College	14	0	1,579	231	0.200	FDG*	1,928	College	1	0	1,054	144	0.081
FACCOR	831	College	1	0	74	18	0.111	ISES*	1,958	College	1	1	64	24	0.091
FPS	839	College	6	0	1,837	244	0.221	FACIAGRA*	1,967	College	2	0	255	59	0.043
ASCES*	880	Univ. Center	17	1	4,425	673	0.288	FBJ	1,969	College	10	7	1,828	350	0.049
UNINASSAU	886	Univ. Center	42	0	21,292	2,170	0.197	ISEP*	1,970	College	2	2	920	222	0.143
FAC. STA. EM.	981	College	7	1	854	144	0.135	UNESF	1,981	College	8	5	547	97	0.078
FAESC*	995	College	6	2	1,006	208	0.205	FAFOPST*	1,986	College	5	5	576	155	0.136
FOR	1,031	College	1	0	127	21	0.455	FACISST*	2,011	College	1	0	234	54	0.148
FADIRE*	1,088	College	3	0	623	239	0.094	FATEC	2,025	College	1	0	110	13	0.037
FAC. JOAQ. NAB.	1,101	College	4	2	378	31	0.286	FACIP	2,027	College	1	0	161	48	0.043
FCR	1,130	College	4	0	617	174	0.106	FACHUCA	2,036	College	4	2	768	70	0.060
FJN	1,143	College	11	1	3,322	464	0.176	FACHUSC*	2,056	College	7	6	1,219	358	0.031
IF Sertão*	1,176	Univ. Institute	12	7	1,724	140	0.225	FAFOPA	2,057	College	7	7	616	168	0.054
FASC	1,180	College	3	1	425	73	0.102	FACISA*	2,083	College	2	0	567	119	0.032
FAFOPAI*	1,241	College	4	4	551	149	0.036	FACAL*	2,092	College	6	3	820	98	0.054
SENACPE	1,274	College	5	0	791	191	0.130	FACRUZ*	2,102	College	1	0	44	11	0.095
FAFIRE	1,284	College	13	4	2,278	447	0.164	UNIVERSO	-	College	13	2	3,988	609	0.164

This table shows the profile of higher education institutions in Pernambuco and their national rank position out of 2,132 institutions evaluated in 2016. * are colleges located outside the metropolitan region of Recife. In 2006, there were 78 higher education institutions in Pernambuco. Column "Grad. stud." shows the total of graduating students in 2016.

Table A2: All Regular Undergraduate Programs Offered by UFPE

Undergraduate Program	Sample	Exp. grad.	Area	Undergraduate program	Sample	Exp. grad.	Area
Accounting	✓	4	Social Sc.	Library Science	✓	4	Arts/Hum.
Actuarial Science		4	Social Sc.	Linguistics and Literature	✓	4	Teaching
Archaeology		4	Geography	Marine Engineering		4	STEM
Architecture	✓	5	Design	Marketing	✓	4	Arts/Hum.
Audiophonology	✓	4	Health	Materials Engineering		5	STEM
Audiovisual Communication	✓	4	Arts/Hum.	Mathematics		4	STEM
Automation Engineering		5	STEM	Mathematics Education	✓	4	Teaching
Biology	✓	4	Health	Mathematics Education (CAA)		5	Teaching
Biology (CAV)		5	Health	Mechanical Engineering	✓	5	STEM
Biology - Medical Sciences	✓	4	Health	Media Communication	✓	4	Arts/Hum.
Biology Education	✓	4	Teaching	Medicine	✓	6	Medicine
Biomedical Engineering	✓	5	STEM	Mining Engineering	✓	5	STEM
Biomedicine	✓	4	Health	Museology		4	Geography
Business Administration	✓	4	Social Sc.	Music (Instrument)		5	Arts/Hum.
Business Administration (CAA)		4	Social Sc.	Music (Vocal)		5	Arts/Hum.
Cartographic Engineering	✓	5	STEM	Music Education	✓	5	Teaching
Chemical Engineering	✓	5	STEM	Nursing	✓	5	Health
Chemistry		4	STEM	Nursing (CAV)		4	Health
Chemistry Education	✓	4	Teaching	Nutrition	✓	4	Health
Chemistry Education (CAA)		5	Teaching	Nutrition (CAV)		4	Health
Civil Engineering	✓	5	STEM	Occupational Therapy	✓	4	Health
Civil Engineering (CAA)		5	STEM	Oceanography		5	Geography
Computational Engineering	✓	5	STEM	Pedagogy	✓	5	Teaching
Computational Science	✓	5	Computation	Pedagogy (CAA)		4	Teaching
Dance		4	Arts/Hum.	Pharmacy	✓	3-5	Health
Dental Medicine	✓	5	Health	Philosophy	✓	4	Pol./Philos.
Design	✓	4	Design	Philosophy Education	✓	4	Teaching
Design (CAA)		4	Design	Physical Activity and Sports	✓	4	Physical Ed.
Economics	✓	4	Social Sc.	Physical Activity and Sports (CAV)		4	Physical Ed.
Economics (CAA)		4	Social Sc.	Physical Education	✓	4	Teaching
Electrical Engineering	✓	5	STEM	Physical Education (CAV)		4	Teaching
Electronics Engineering	✓	5	STEM	Physics	✓	4	STEM
Energy Engineering		5	STEM	Physics Education (CAA)		4	Teaching
Engineering		5	STEM	Physics Education	✓	4	Teaching
Food Engineering		5	STEM	Physiotherapy	✓	5	Health
Geography	✓	4	Geography	Political Science		4	Pol./Philos.
Geography Education	✓	4	Teaching	Production Engineering	✓	5	STEM
Geology	✓	4	Geography	Production Engineering (CAA)		5	STEM
Graphic Arts	✓	4	Arts/Hum.	Psychology	✓	4	Health
History	✓	4	Geography	Public Health		4	Health
History Education	✓	4	Teaching	Secretarial Science	✓	4	Arts/Hum.
Hotel Management	✓	4	Tourism	Sign Language Education	✓	4	Teaching
Industrial Chemistry	✓	5	STEM	Social Sciences		5	Social Sc.
Information Management	✓	4	Social Sc.	Social Science Education	✓	4	Teaching
Information Systems		4	Computation	Social Service	✓	4	Pol./Philos.
Journalism	✓	4	Arts/Hum.	Statistics		4	STEM
Language Education (French)	✓	4	Teaching	Theatre	✓	4	Arts/Hum.
Language Education (English)	✓	4	Teaching	Tourism Management	✓	4	Tourism
Language Education (Spanish)	✓	4	Teaching	Visual Arts	✓	4	Arts/Hum.
Law	✓	5	Law				

This table shows all current undergraduate programs offered by UFPE and those included in the sample. It does not include special programs. "Expected graduation" is the number of years necessary to obtain the major degree. CAA and CAV are campi located in other cities.